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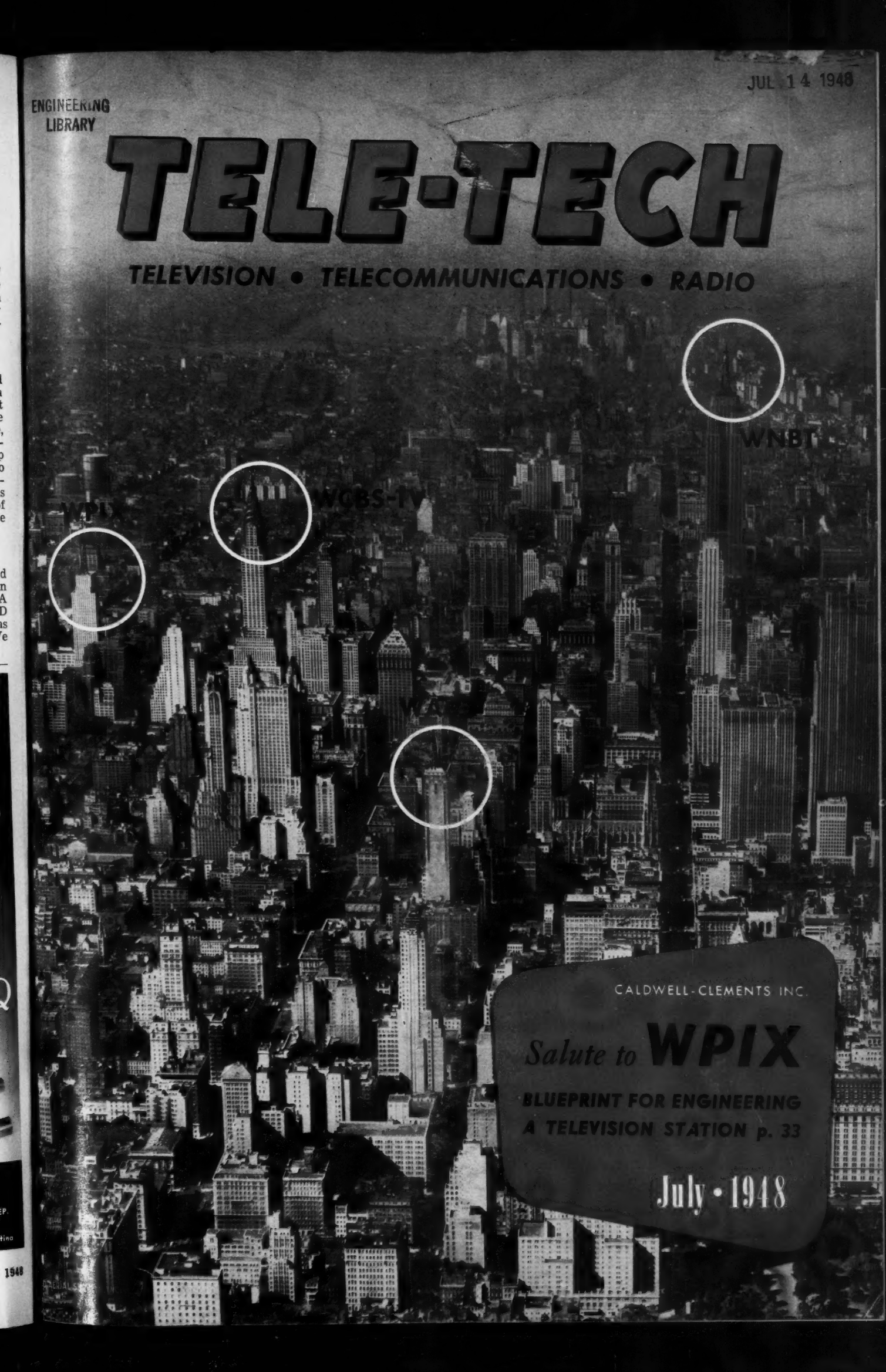

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Salute to **WPIX**

BLUEPRINT FOR ENGINEERING A TELEVISION STATION p. 33

July • 1948

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JULY, 1948

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COVER: Television in the New York metropolitan area. WCBS-TV and WNBT have been on the air since August, 1941; WABD went on the air in May, 1944; WPIX went on the air June 15. WATV, Newark, went on the air this past May. It is not shown, being outside the range of the aerial map.

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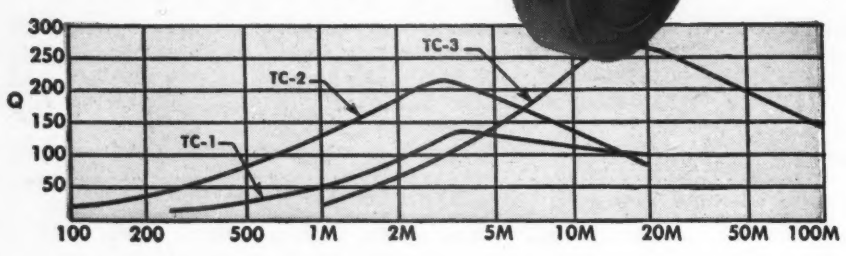

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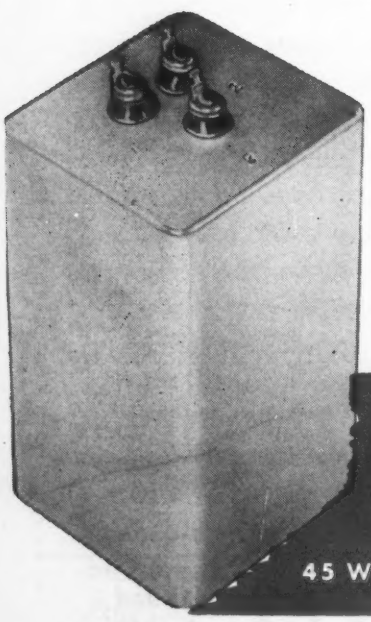

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TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

BIG RADIO AUTUMN AHEAD!—Once again, radio demand is back in the familiar prewar pattern: "Slow sales" in the summer months; "Big rush to buy" in the fall and winter! During the war and immediately thereafter this seasonal pattern was not so apparent. Now it is reasserting itself. And radio makers, radio engineers and radio trade must all realize that radio's annual swing is obdurate and immemorial. With monthly sales volumes expressed as percentages of the year's total, the spring and summer months thus line up—April 6%, May 5%, June 6%, July 4%, August 6%. Then the golden comeback—September 8%, October 11%, November 12%, December 18%. As dawn follows night, the present summer slump will be succeeded by a big radio uptrend in the autumn and winter ahead!

PRICE-CUTTING SUICIDE now being indulged in by many television manufacturers is totally without need or reason. At the moment television sets are in unprecedented popular demand. The public is crying for video. Yet short-sighted TV makers keep paring down selling prices with an eye only to undercutting some other fellow's schedule and discount, and ignore the factual costs of parts, labor and general production. Even the distribution costs are hacked and whittled away in the resulting slim margin, so that the retailer must operate at a loss when all his costs are figured.

With television volume sweeping upward, now is the time to stabilize prices so that a sound industry and distribution trade can be built—with profit for all.

TO GET MORE TV CHANNELS?—Alyready television is being constricted by the dwindling number of available channels in the major metropolitan areas. With our existing TV-FM allocation by FCC, only 7 TV stations can serve a given locality. But if FM bands were "interleaved" as guard bands between adjacent TV channels below 108 mc, as follows:

TELEVISION	FM
54 to 60 mc	60 to 66 mc
66 to 72 mc	72 to 78 mc
78 to 84 mc	84 to 90 mc
90 to 96 mc	96 to 102 mc
102 to 108 mc	

this would seem to provide more TV stations in city areas, reduce adjacent-channel interference, and provide more FM channels in areas where the demand has exceeded the supply. Of course, there are some disadvantages with respect to FM receiver design. However, no TV or FM receiver would become obsolete because of inability to receive at all.

SALUTE TO WPIX ★ ★ ★

A COMPREHENSIVE blue print for engineering a television station is presented as a special section in this issue of TELE-TECH, beginning on page 33. The station—WPIX—went on the air commercially in New York June 15. Its selection for this study is particularly appropriate as an example of a postwar, independent station fully equipped to be self-sufficient in the world's greatest metropolitan area.

This marks the first time that such a comprehensive study of a television operation has ever been blueprinted for publication. The editors spent weeks in compiling pertinent engineering data about the construction, equipment installation and operation of WPIX. While not a typical installation because of its size and scope, any combination of its engineering details are adaptable to typical television station requirements.

The complete story, which we present exclusively, covers engineering details on construction of the building, studio design, antenna and transmitter installations, control room operations, film projection methods, audio system, remote technics, power supply, organization and programming policy.

The Daily News Syndicate, owner of WPIX, has spent more than $1,500,000 to equip the station and get it on the air. Its operating budget is expected to exceed $750,000 annually. Present number of employees total approximately 150. Of the total costs to date, $600,000 was for equipment, $575,000 for construction, $350,000 for accessories. Full costs have not yet been tabulated. Basic airtime rate for the station will be approximately $800 per hour.

Much of the credit for the basic planning for WPIX belongs to station manager Robert L. Coe and chief engineer Thomas E. Howard, assisted by William Sloat, in charge of engineering and Otis Freeman, in charge of operations.

How HIGH is High Fidelity?

Review of high fidelity philosophies reveals disagreement as to the value of extended frequency response; binaural system shows reproduction improvement

By ***MARVIN CAMRAS****, Armour Research Foundation, Illinois Institute of Technology*

EVER since it became possible to store sound on a record and to reproduce it later, the recording engineer has tried to secure "perfect fidelity" of reproduction. Suppose we define "perfect fidelity" to mean that the playback cannot be distinguished from the original by any observer.

The goal being so clearly outlined, let us go back to 1910 and examine some of the engineer's efforts at perfect fidelity. For working apparatus he has a phonograph disk, a sharp stylus attached to a vibrating diaphragm and a horn coupled to the diaphragm. Why doesn't it sound like that original? The engineer has been listening to his experimental phonograph for so long that his senses are numb. He asks one of his non-engineering friends for an impartial opinion. His friend tells him:

a. The low notes are missing.
b. The high notes are missing.
c. The in-between notes sound hollow.
d. Needle scratch is annoying.
e. Sustained tones are sour.

The engineer says, "Maybe so, but we're selling millions of them."

Although given in non-technical language, the analysis was true. Most of the trouble was with poor frequency response, and for many years the engineer tried to extend the upper and lower ranges as well as to eliminate sharp peaks. This work, mainly of the "cut and try" variety, where different sizes, shapes and materials were used for needles, diaphragms, and horns, yielded no remarkable improvement for the next 15 years.

In 1926 Maxfield and Harrison of Bell Labs announced a new approach. In early days of electrical development, mechanical analogies had been used to help understand electrical theory. Now the tables were turned. Electrical theory had advanced to where it became advantageous to set up electrical analogies of mechanical systems. The mass of various moving parts was represented by inductance. Mechanical elasticity or stiffness was represented by capacitance. Friction or damping was represented by resistance. Similarly, the acoustic quantities were converted to equivalent electrical quantities.

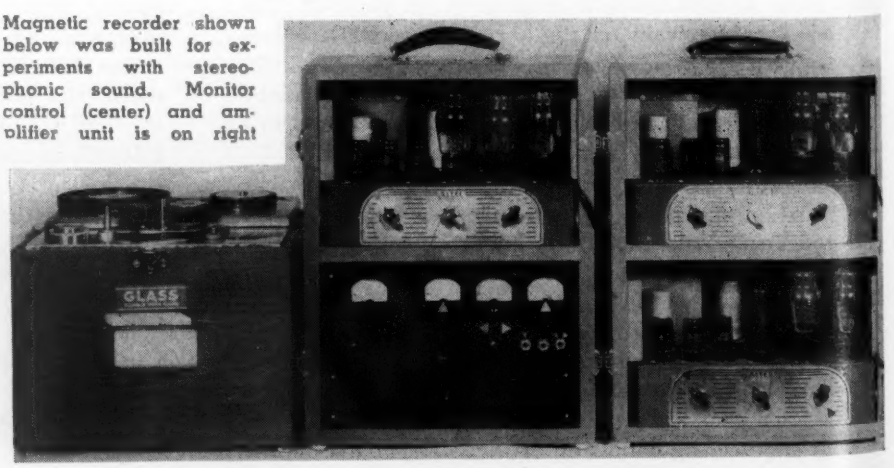
It now became possible to draw electrical networks which represented the pickup unit or cutter head and these turned out to be bandpass filters. Filter theory previously worked out for telephone networks showed what components should be changed in which direction in order to broaden the pass band. This new tool for analysis, together with electrical methods of recording and reproduction and with improved record materials, changed the entire sound reproduction picture.

Frequency response was no longer a problem for it was now possible to record frequencies from 30 to 15000 cycles, all that the ordinary ear could perceive. The overall result of the improved reproduction was amazing to anyone who was used to the old phonograph records, but the ear was not completely fooled. The extended range brought out many distortions and imperfections that previously could not be heard. Surface noise was still a problem, as was maintaining constant speed to a small fraction of one percent.

High Fidelity Philosophy

According to response curves the speech and music should sound good. According to the ear it didn't sound quite right. From this situation several schools of thought arose and these were the forerunners of modern "high fidelity" philosophies.

Group I:—Extended frequency response is worth while. This group says, "The public has heard low fidelity phonographs and radios for so many years that they are accustomed to poor quality, and



Magnetic recorder shown below was built for experiments with stereophonic sound. Monitor control (center) and amplifier unit is on right

reject anything different without considering whether it is really better." As a matter of fact, one old timer, when he first heard the improved recordings, was amazed. He said, "That's the most wonderful thing I ever heard, but the trouble is that it doesn't sound like a phonograph."

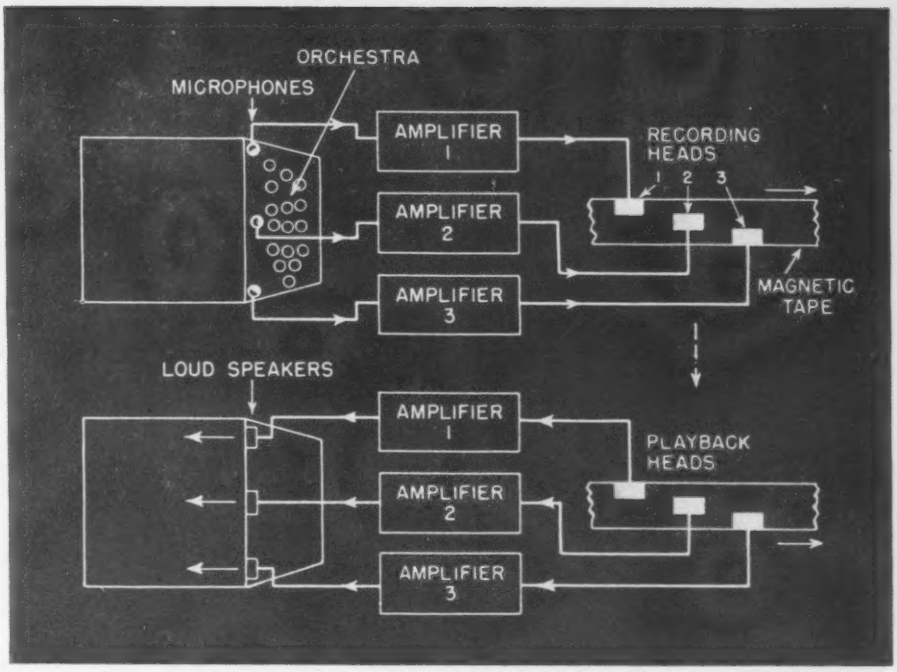
To educate the public may take a long time, especially since high fidelity is expensive. In the meantime the enlightened engineer and music lover can listen to the full range if he can stand needle scratch and intermodulation distortion which are sometimes deafening. Group I used to be most popular about 10 years ago, but now most of its members have gone over to other groups.

Group II:—Extended frequency response is inherently undesirable. Engineers in Group II are usually ex-members of Group I. Their attempts at high fidelity met with discouraging results even though the best equipment was used. The conclusion they reached is that for psychological reasons an extended high frequency response is unpleasant even if distortionless.

There is much evidence to support this conclusion. A number of listener preference tests have been conducted in recent years under widely varying conditions, and in practically every case the listeners indicated that they liked the highs cut out. When sound on film was first perfected, equipment was made flat to 10,000 or 15,000 cycles. After years of experience the Motion Picture Acadamy has standarized on a response flat to 3000, down 9 db at 5000, and down 20 db at 7500 cycles.

Mellow Music Preferred

Tests of best violins, pianos and other musical instruments indicate a drop in the high frequency range as compared to poor instruments of the same kind. Apparently the makers of these instruments have tried to eliminate high frequency components as far as they were able. Now we have a new tool, the electric filter or tone control, and the public by its use has indicated that it prefers to have the highs cut still further. Who is to say they are not right? One band leader hired an engineer to put electric pickups on the bass instruments with instructions that he wanted the overall effect to be "like a juke box."



Block diagram of typical setup for 3 channel stereophonic recording and playback on a single tape. Note microphone locations in orchestra pit for the full sound pickup

Tests have also indicated that music rich in high frequencies requires more of the listener's attention than "mellow music." While the former may be satisfying to one who gives it his entire attention, low pitched music is definitely less distracting when used as a background for conversation, working, dining, etc.

The above reasoning seems logical, but not everyone believes it, so we have still a third school of thought: Group III: — Extended frequency response would be satisfactory if we could eliminate distortion. This is a safe group to belong to since no one has ever been able to get rid of all distortion, therefore no one can prove that a member of Group III is wrong. Some engineers of this group will tell you that if the reproduction does not sound perfect, that in itself is evidence of distortion. This is going around in a circle and getting nowhere, but fortunately most members of Group III have a pet theory as to which distortion is most harmful (and some of them may be right). Let us list some of these distortions:

1. *Harmonic distortion.* Third, fifth, seventh, and higher odd harmonics are especially bad. Harmonic distortion was once an old standby but is not discussed as much as it used to be.

2. *Intermodulation distortion.* This is the "new look" as far as fashions in distortion go. Both intermodulation and harmonic distortion are different ways of expressing non-linearity, and ordinarily if one is known the other can be closely estimated.

3. *Phase distortion.* Components of a complex wave may not be in the same relation as in the original wave, even though they are of the correct amplitudes. Text books say that the ear is not sensitive to phase, but "phase advocates" say the textbooks are wrong. To produce phase relations correctly over the entire audible range, a system must have a response down to about 1/10 the lowest frequency and up to 10 times the highest frequency—which means components flat from 3 to 150,000 cycles.

4. *Transient distortion.* Equare waves and pulses must reproduce properly, calling for a system flat from 3 to 150,000 cycles.

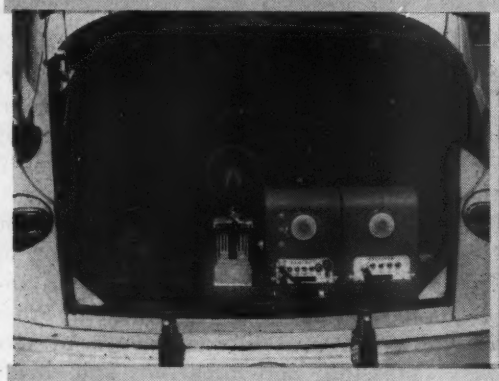
5. *Hangover.* Loudspeakers or resonant circuits in the system are not critically damped, and will

(*Continued on page* 106)

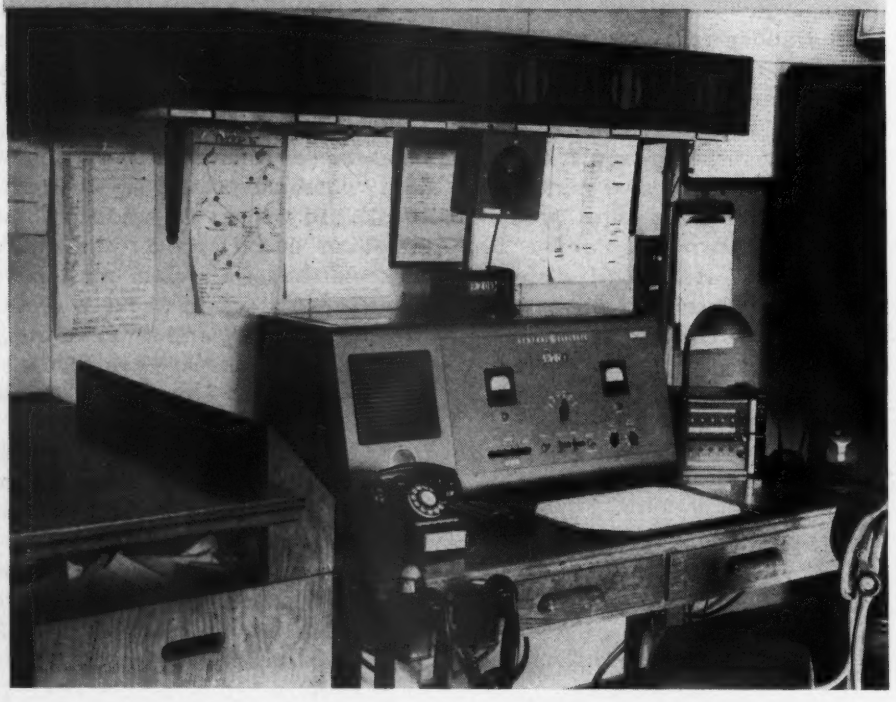
Bridged

Above: Showing state trooper transmitting from patrol car with 2-way mobile installation

Below: (left) Patrol car installation and (right) portable transmitter with power supply



Below: Troop headquarters master control station. Circuits from troop zones converge here



AN FM radio-telephone system that makes it possible for Troopers on patrol to talk with other patrols in their vicinity, with their sub-stations, or if occasion demands, with troop headquarters and division headquarters in Albany, has been inaugurated by New York State Police. The system conversely enables any headquarters to talk with its troops, sub-stations or patrols, or to broadcast alarms to a part or all of them simultaneously.

The new installation, leased from the American Telephone and Telegraph Co., replaces AM one-way system. Forty-one fixed transmitting and receiving stations are provided to cover the state. These land stations, with the 363 mobile transmitter-receivers in police cars and boats, are the basic radio elements of the system. In addition there are 42 walkie-talkies and 16 portable transmitter-receivers in trunks; portable generators are available throughout the state to furnish power as communications centers in disasters and other emergencies.

An unusual feature of the new radio set-up is the wire network and switching facilities especially designed by the Bell Telephone Laboratories to integrate the land-radio stations and police stations into a system of great flexibility.

New York State's division of state police is composed of 6 troops. Each troop is divided into zones, usually 3. A zone has several sub-stations, one of which serves as a zone headquarters. Each zone has at least one land transmitting and receiving station. Wire circuits from all sub-stations and all land radio

Prepared from material made available by George M. Searle, Deputy, New York State Police.

Circuits Facilitate Police Radio

Network ties in 360 mobile sets and 16 portable stations without interference from each other, yet permits transmission in either direction

stations in the zone converge at a zone "bridge," usually in a telephone central office building, from which a circuit leads to troop headquarters.

A message coming into the zone bridge on any of these circuits goes out on all the others. By operating a 3-way key at his radio console a trooper in the sub-station controlling a land radio transmitter-receiver may, using the same radiotelephone instrument, talk over the air only, or talk over the wire network only, or connect the radio to the wire network so that he, troop headquarters, State headquarters, or any other sub-station in his zone, may broadcast over the air and talk to all stations on the wire network simultaneously, with all stations hearing the replies from patrols.

Zone Circuits Converge

With circuits from all its zones converging at troop headquarters, the troop communication center can use any or all of the zone networks, including the radio facilities, at will. A bank of monitoring loudspeakers in the troop communication center brings in all messages on the zone networks, whether or not the troop headquarters is connected to them for transmission.

Wire circuits from troop headquarters converge at division headquarters in Albany. By means of these, Albany headquarters can similarly monitor on or use for communication any or all troop networks and through them any or all of the zone networks and radio stations throughout the state.

Most of the 41 transmitting-receiving stations throughout the state have 250-watt transmitters. A few, which fill in gaps in the coverage of the more powerful stations, have 60-watt transmitters, and the 16 portable stations held in readiness for emergencies also have 60-watt transmitters. The 363 mobile sets have 30-watt transmitters.

General Electric fixed-and-mobile radio equipment is used throughout the state, except on Long Island, where Link equipment is used. To insure adequate power supply for the mobile units over a wide range of driving conditions, the generators in all vehicles were replaced by Leece-Neville equipment.

Land stations transmit on a frequency of 42.14 mc. Mobile stations transmit on a 42.3 mc frequency when talking with land stations, but are changed to the 42.14 frequency by the operation of a button on the control panel for car-to-car or car-to-boat communication. All sub-stations are equipped with monitoring receivers tuned to the 42.14 frequency so that they may hear communications between mobile units. Walkie-talkies send and receive on the 42.14 frequency. Besides being able to communicate two ways with cars and other walkie-talkies in their vicinity, they can hear the local land transmitter and be heard by monitoring receivers at sub-stations within walkie-talkie range.

Special Bridge Circuits

An unusual feature of the network and switching facilities is the bridge in each zone, each troop area, and at Albany headquarters. These bridges tie a number of circuits together in such a way that they do not interfere with each other, yet transmission can readily take place in either direction.

The system is operated on a push-to-talk basis, and one of the major apparatus units of all the bridges is the reversible amplifier that changes from one direction of transmission to the other as the push-to-talk switch on the hand telephone is pressed or released.

Every sub-station, whether it is only a dispatch station or the remote control station for a land transmitter-receiver, has a console in which is terminated the network circuit from the zone bridge. In the console are incorporated an amplifier for incoming and outgoing speech, a loudspeaker and associated switching arrangements, power supply and miscellaneous equipment such as gain and squelch controls, attention tone oscillator, and meters. Automatic sending volume control is provided at state and troop headquarters. At substations, the operator adjusts his voice level by watching a volume indicator. Receiving volume may be adjusted manually at any terminating point.

If the substation is the remote control station for a land transmitter receiver, it has a second

(*Continued on page 94*)

RF Spectrum Analyzer

Plots Fourier components of pulsed waveforms occupying bandwidths of 100 kc or less between 0.5-15 mc; has 5 tubes; resolution is 500 cps

By ***PETER G. SULZER,*** *Electrical Engineering Dept., Pennsylvania State College*

THE radio frequency spectrum analyzer was developed for the purpose of obtaining a plot of the magnitudes of the Fourier components of a pulsed signal. It is useful for the analysis of any periodic waveform that occupies a total band of 100 kc or less and lies within the frequency range of the equipment.

Although it is similar to the panoramic devices that have been used with communications receivers, it is considerably more versatile, since the selectivity, deviation, and center frequency are all continuously variable, and only 5 tubes are employed.

The center frequency of this device can be varied from 0.5 to 15 mc, while the deviation is adjustable from 0 to ±50 kc. The selectivity defined at the 3 db down points is variable from 500 cycles to 30 kc. An input of at least 0.1 volt rms is required; the output for this input is 0.2 volt peak.

Referring to Fig. 1, the spectrum analyzer is essentially a double superheterodyne receiver with a frequency modulated second converter. As used, the output of the analyzer is applied to the vertical deflection amplifier of an oscilloscope. The horizontal sweep voltage is derived from the same source that frequency-modulates the second converter. The result is that the signal components appearing within the frequency range of the equipment will appear as pulses on the oscilloscope base line which is calibrated in frequency. These pulses will be discrete if the signal components are separated by an amount equal to or greater than the bandpass of the spectrum analyzer. Otherwise, the pulses will be run together, and a continuous envelope will be obtained.

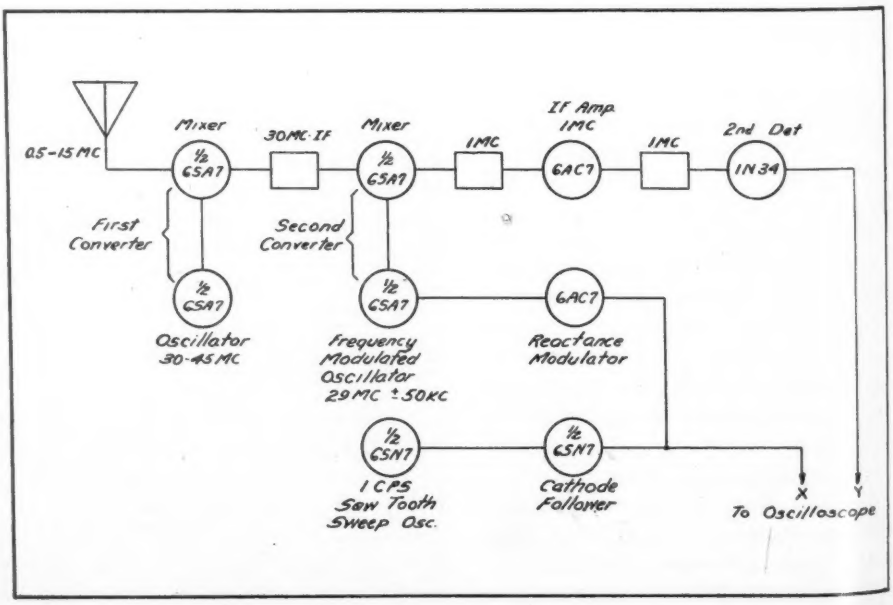
The signal to be analyzed is applied to the input of V_1, a Type 6SA7 pentagrid converter as in Fig. 2. The oscillator section of the converter is tuneable from 30 to 45 mc. Therefore, inputs between 0 and 15 mc can be changed to the 30 mc IF. An input level control is provided so that blocking can be avoided, but no amplification occurs at this IF since the device was not intended to have high sensitivity.

The first converter drives the second converter, V_2, through a single-tuned circuit having a bandwidth of about 600 kc. This is sufficient to pass the signals being measured without noticeable distortion. The second converter, which is also a Type 6SA7, changes to a lower intermediate frequency of 1 mc. The oscillator section of this tube is frequency-modulated by V_4, a 6AC7 pentode connected as a reactance tube, (center frequency = 29 mc) with a deviation from 0 to ±50 kc.

The reactance tube is driven by a blocking oscillator using one section of V_5, a 6SN7GT dual triode. This oscillator also drives the horizontal deflection amplifier of the oscilloscope through the other section of V_5, connected as a cathode follower to provide a low impedance output. Two sweep rates are available: one per second and 10 per second. The former is particularly useful for observing signals with repetition rates of less than 100 per second. Line frequency synchronization will occur at the higher rate, providing a more stable oscilloscope pattern.

The IF amplifier, V_3, a 6AC7 pentode operating at 1 mc, has some regeneration provided by a small capacitor connected between plate and control grid, while degeneration is caused by resistance in the cathode circuit. The result is a high maximum selectivity when the re-

Fig. 1: Analyzer is a double superhet receiver with frequency modulated second converter



generation control in the screen circuit is set fairly close to the point where the stage would break into oscillation. By means of this control, it is possible to vary the passband from 500 cycles to 30 kc at 3 db down points. The maximum selectivity is equivalent to a Q of 2000 at one mc.

The second detector is a 1N34 crystal diode which operates at a comparatively low level. As a result, its characteristic is nearly square law so that the output voltage, observed on an oscilloscope, is proportional to input power. The amplitude response of the regenerative intermediate frequency amplifier stage is linear over the range of interest.

It should be noted that the IF amplifier is blocked by the output of the oscillator part of the first converter, V_1, if that oscillator is set to frequencies between 30 and 30.5 mc. The device is, therefore, not useful at less than 0.5 mc.

Fig. 3 shows 3 oscilloscope patterns obtained with the spectrum analyzer. In these patterns the length of the base line corresponds to 30 kc, while the center frequency is 6.425 mc. The signal being examined is the output of a pulsed oscillator used for ionospheric measurements. The upper pattern is for a one-half sine-wave pulse shape with a duration of 75 microseconds.

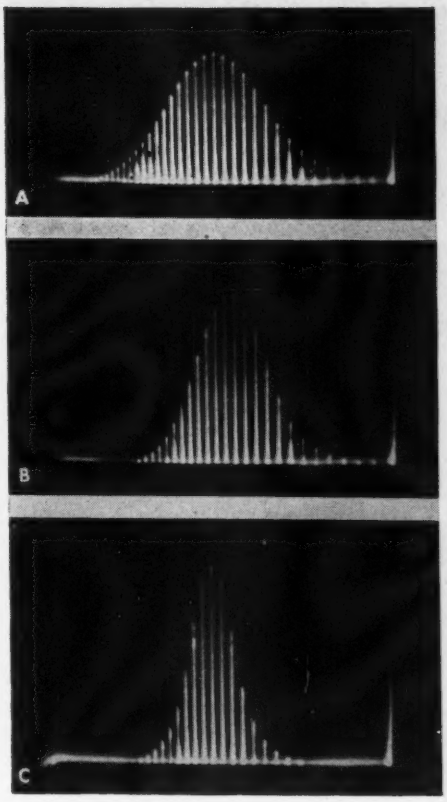
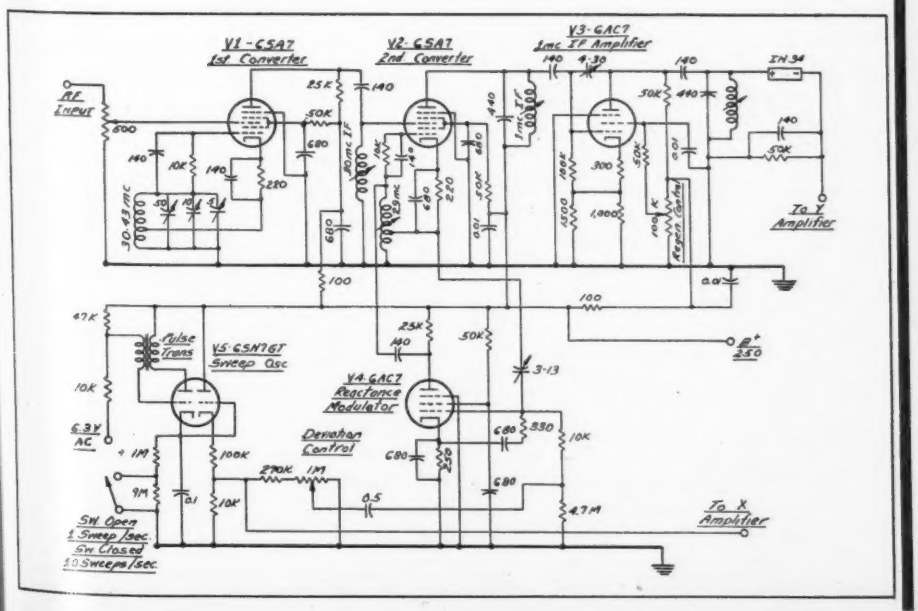


Fig. 3: Patterns obtained with the analyzer

The center pattern is the same except that the pulse duration has been increased to 200 microseconds. The lower pattern indicates the effect of changing the pulse shape to a gaussian form. The result is a very material reduction in the bandwidth of the signal.

Fig. 2: Schematic of amplifier, converter circuits and deviation control in analyzer



URSI-IRE Review Radio Developments

THE spring meeting of the International Scientific Radio Union held in Washington in May brought to light many interesting aspects of radio research and new developments in the field of communications. Registration totalled 562. A majority of the papers presented were by National Bureau of Standards and Naval Research Laboratory personnel, although a number of colleges and such organizations as Bell, RCA, Philco and others contributed to the sessions. An international flavor was added by papers from Sweden, Egypt, France and Canada. The next general assembly was scheduled for Stockholm, Sweden, July 12 to 22, 1948.

A brief resume of a few of the papers follows:

Elimination of reflected signal effects in pulsed systems was discussed by D. O. Collup, Naval Research Lab. Object of the research was to prevent transponder beacons on the ground, which should respond to only a 2 microsec interrogation pulse, from answering strong 1 microsec pulses of a sweep transmitter. An echo suppressor, designed by the author, greatly reduced the area around a ground beacon so that an enemy-controlled transmitter could not cause interference. At the same time the usual range of the beacon is not reduced by the suppressor.

Leo Craig of Evans Signal Lab. described an improved radiosonde operating on 1680 mc. The instrument contains special transmitter tubes modulated by a blocking oscillator whose frequency is controlled by various circuits. In these, the R is varied by such changes as humidity, pressure, etc.

Optical radar for surveying was discussed by W. W. Hansen, Armour Research Foundation. Accuracy of the system described is 1 min. of arc; a few yards in 5000 yards.

Two additional subjects of major interest were on the calculation of radio attenuation between 200 and 10,000 mc, and on an antenna for use over the wide band 1 to 25 mc. These will be discussed next month.

Reducing STRAY INPUT Pickup

Controlling unbalance of a differential amplifier minimizes undesired signal transmission

By PETER L. RICHMAN, Reeves-Ely Labs., Inc., New York

INPUT-STAGE lead shielding is often inadequate as a means of eliminating pickup, especially when the input stage is at a distance from the signal source or when the pickup level at the signal source is unusually high. In this event it is possible to use a preamplifier the purpose of which is to reject stray signals while amplifying the pertinent signal. The commonest type of circuit for this purpose is the differential or cathode-coupled amplifier, although in simplest form its results are questionable.

One method of increasing the rejection accomplished by the differential amplifier of signals common to both input grids is to distort the amplification factor of one tube.* At first glance this seems incongruous; to unbalance the μ's in order to "balance" the circuit. Analysis shows, however, that this unbalancing of the two amplification factors is necessary to secure the optimum condition for rejection of common signals.

Let A_{11} be the gain at plate 1 due to a signal e_{gn1} between the grid of tube 1 and ground.

Let A_{12} be the gain at plate 1 due to a signal e_{gn2} between the grid of tube 2 and ground.

Let $R_1 = r_{p1} + R_{L1} + (\mu_1 + 1)(R_k + R_{k1})$ ..... (1)

and $R_2 = r_{p2} + R_{L2} + (\mu_2 + 1)(R_k + R_{k1})$ ..... (2)

Then analysis of the circuit shows that

$$A_{11} = -\frac{\mu_1 1 R_2 R_{L1}}{R_1 R_2 - (\mu_1 + 1)(\mu_2 + 1)R_k^2} \quad (3)$$

and

$$A_{12} = \frac{\mu_2(\mu_1 + 1)R_k R_{L1}}{R_1 R_2 - (\mu_1 + 1)(\mu_2 + 1)R_k^2} \quad (4)$$

In order that the output at plate 1 be entirely free from a signal applied equal in both magnitude and phase to both grids, A_{11} must equal minus A_{12}. Then from the relations expressing A_{11} and A_{12} in terms of the circuit parameters it is evident that for optimum common mode rejection,

$$\mu_1 R_2 = \mu_2(\mu_1 + 1)R_k \quad (5)$$

since the denominators of the equations for A_{11} and A_{12} are equal, and R_{L1} is common to both equations.

Substituting (1) and (2) in (5) yields

$$R_{k2} + R_k + r_{p2} + R_{L2} = \frac{\mu_2}{\mu_1}(R_k - \mu_1 R_{k2}) \quad (6)$$

Solving explicitly for μ_1 gives

$$\mu_1 = \frac{\mu_2}{1 + \dfrac{r_{p2} + R_{L2} + R_{k2}(1 + \mu_2)}{R_k}} \quad (7)$$

Equation (7) is the relation which defines the condition for optimum rejection of common signals in the generalized differential amplifier. Cursory inspection of equation (5) would lead one to believe that the optimum conditions would be best approximated when the two amplification factors are equal, while the analysis shows subsequently that this is not the case, that the amplification factors must be unequal.

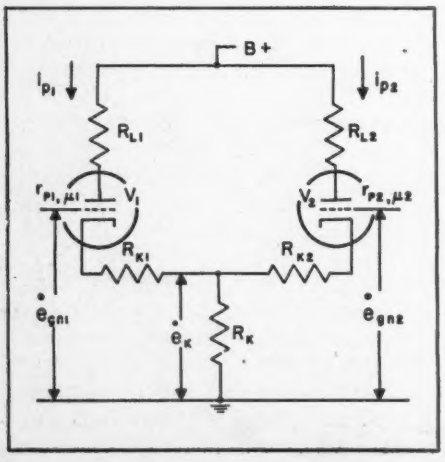
For a given tube and a given R_k, μ_2 is held constant and μ_1 is calculated from the defining relation (equ. (7)). This value of μ_1 may be secured by shunting tube 1 with a suitable resistor. It will be found that the value of μ_1 calculated from equation (7) will not quite give optimum rejection of common signals since the relation is dependent upon the balance of the circuit in every respect save μ—balance: i.e., equal load resistors, equal plate resistances, etc. The calculated value of μ_1 does, however, give a general idea of the region of μ_1 in which the optimum effect may be secured subsequently by trial and error. Rejection of signals common to both input grids of the preamplifier amountnig to better than one part in eight thousand have been secured with high—μ tubes.

After the preamplifier has been adjusted to give optimum performance, both input leads should be brought to the signal source, where one lead is coupled to ground (or to a dc bias voltage) by a coupling network identical with that which couples the other input lead to the signal source. It is important that the grounded lead be grounded at the same place that the signal is impressed on the other lead. The two input leads are then cabled together (and shielded) so that stray voltages will be picked up in the same amount by both leads.

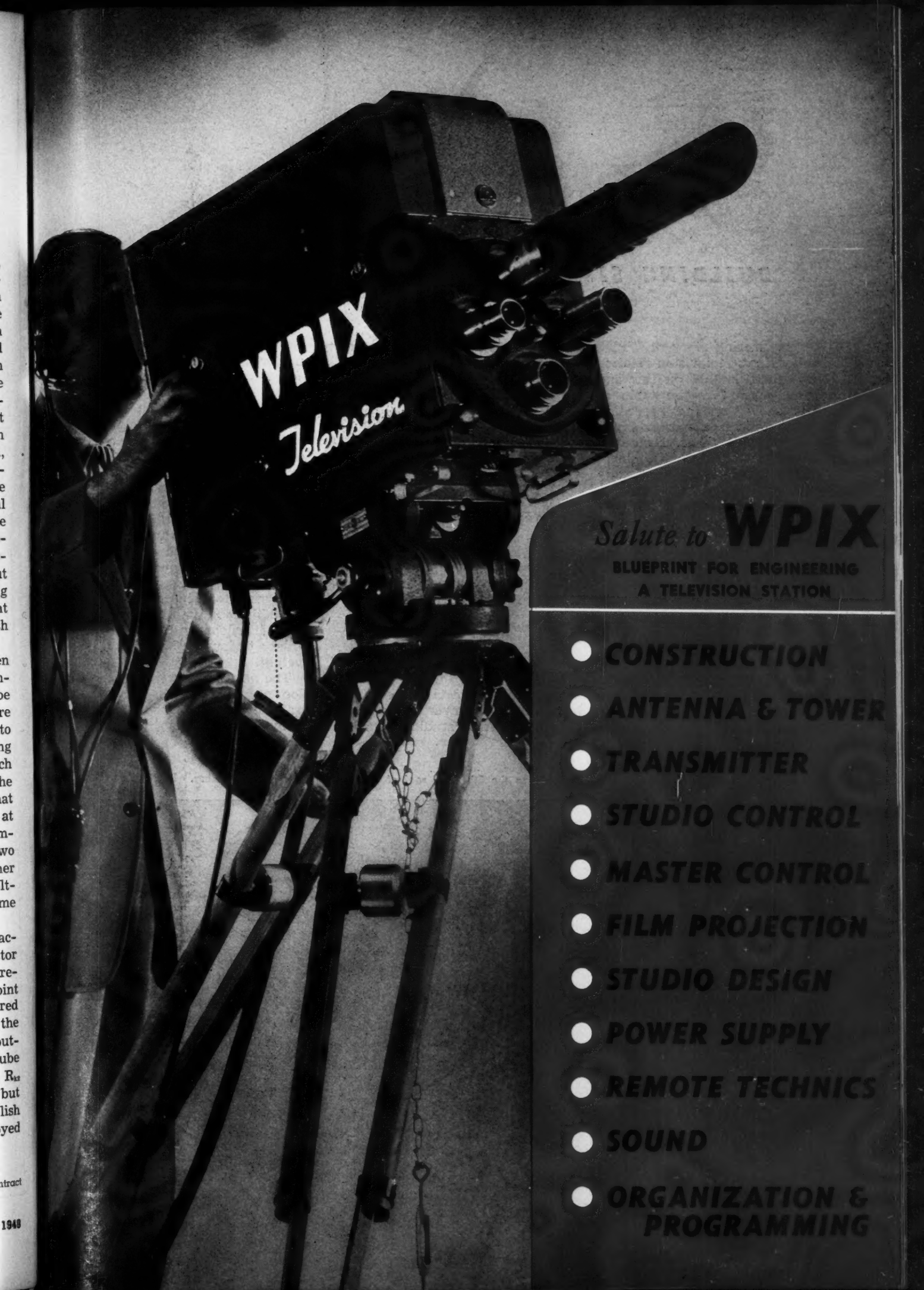
Best results will be secured practically by allowing the load resistor of tube 2 to go to zero, thereby reducing drift of the optimum point with time. This affects μ_1 required for optimum operation but not the circuit configuration since the output is taken off the plate of tube one. Allowing resistors R_{k1} and R_{k2} go to zero as well helps slightly, but it is often impossible to accomplish if feedback is to be employed around the entire amplifier.

*J. F. Toennies, "Differential Amplifier", R.S.I., 9, 95, (1938). In this article the author covers one phase of the above analysis by physical reasoning.

Amplifier schematic. Unbypassed cathode resistors facilitate using negative feedback



Research done under Signal Corps contract No. W-36-039 at MIT Research Lab.


WPIX
Television
Salute to WPIX
BLUEPRINT FOR ENGINEERING
A TELEVISION STATION
CONSTRUCTION
ANTENNA & TOWER
TRANSMITTER
STUDIO CONTROL
MASTER CONTROL
FILM PROJECTION
STUDIO DESIGN
POWER SUPPLY
REMOTE TECHNICS
SOUND
ORGANIZATION & PROGRAMMING

WPIX

CONSTRUCTION

BUILDING SITE • FLOOR PLANS • FACILITIES

THE engineering story of WPIX, Daily News television station in New York, is told on this and following pages. As the table of contents shows on the preceding page, the story is a master blueprint of what it takes, besides a channel assignment, to put a television station on the air. WPIX constructed facilities, procured and installed equipment, tested its pattern, created and rehearsed programs and went on the air commercially June 15, or in approximately 90 days. The entire job was an engineering achievement.

At the outset it was determined that existing facilities in the Daily News Building, an addition above the 36th floor for transmitter and tower, and two new floors above the 9th-floor roof of a wing of the building for studio facilities would provide minimum working areas for a television station.

Television station WPIX went on the air in New York on June 15, thus completing a construction and engineering job within 90 days. The story of this engineering achievement is told on the following pages and comprises a regular blueprint for engineering a television station. This blueprint should serve as a guide to others planning television stations in the months to come.

The men responsible for WPIX are identified on p. 55.

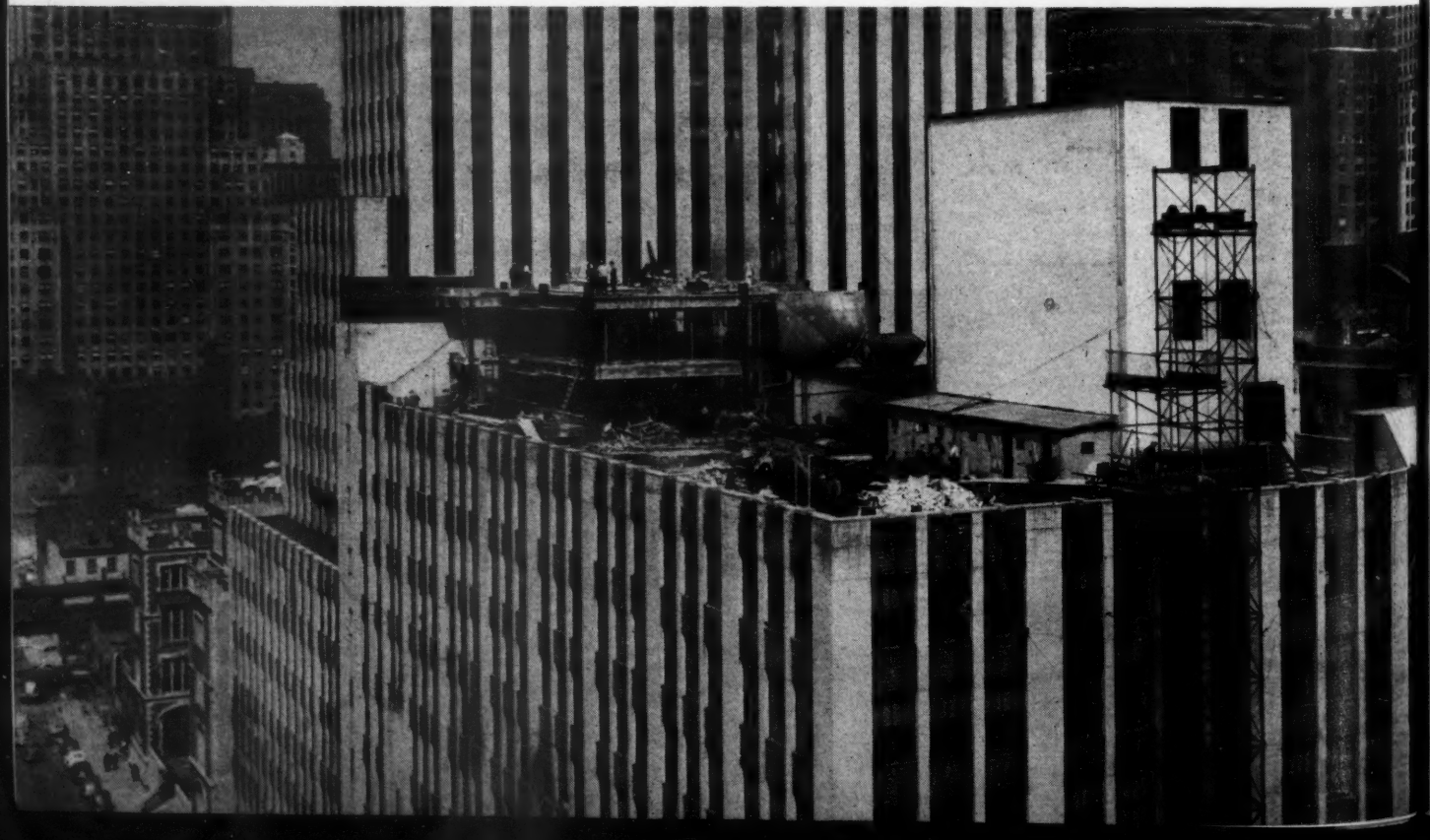
Because of the limitations within which the architects and engineers had to work, however, it was necessary to separate studio and studio control operations from the transmitter and its supporting facilities.

A 3-story high parapet which rose above the 36-story high News Building served as a site for the News' meteorological station. An extra story was added to this part of the building to make a 37th floor for the transmitter room.

Since the walls already existed, only the roof had to be constructed. Ten feet above this roof level, steel beams were put in to form an open foundation for the tower. These beams connected on the sides with the existing walls. It was found necessary to reinforce columns on the 36th floor with concrete and on the 34th floor with steel plates in order to support this additional weight.

The new construction on the 37th floor provided 8 rooms, including the transmitter room, in a total area of 58 by 80 ft. A major portion of the

The 10th and 11th floors for the studio were built above the 9th floor roof of one wing of the News Building. Photo shows location



Transmitter room and facilities were built above the 36th floor roof. The base of the tower is supported by the 37th floor roof (right)

space was allocated to the transmitter room whose inside dimensions are approximately 25 x 33 ft.

The layout of the equipment allows ample space for working around the transmitter. Four feet of additional ceiling height allows space for servicing the upper part of the transmitter, room for discharge of heat, etc.

The Turner Construction Co., who performed the construction job, also built a 2-story structure on the 10th floor level to provide for studio, control room, film projection room and other facilities. This structure rises above the 9th floor wing of the building where the newspaper presses are located. Two floors were added each 11½ ft. high within an area of 54 x 110 ft. There are 12 rooms on the 10th floor and 7 rooms on the 11th.

The No. 1 studio is 2 floors high (10th and 11th floors) and measures approximately 28 x 46 x 22 ft. It is isolated as a room within a room to prevent it from being affected by vibration from the newspaper presses. Details of the isolation are given in the section on studio design. The sponsor's gallery, transcription library, recording room, studio control room, air conditioning and washroom facilities are on the 11th floor. Grouped about the ground floor of the studio are the news and accessory rooms, 2 dressing rooms, film projection and master control rooms, work shop and washrooms.

Office facilities are located on the 10th floor of the News Building itself where space was provided for management and sales, news, program, publicity, promotion and other functions. A new doorway cut into one wall of the 10th floor provides access to the adjacent new structure rising above the 9th floor roof.

The new studio required 110 tons of steel to be hoisted up the side of the building from the street. The structure is steel frame with cinder concrete floor arches and brick-faced walls.

It was necessary to raise almost all of the structural material for the new area by derrick; small building sections and some bulk material were brought up by freight elevator. The first derrick was installed on the roof of the 9th floor. This derrick had a boom of 40 ft. and to raise it, a small derrick and hoisting engine had to be taken apart, brought up by elevator and reassembled on the roof. The 40-ft. boom was later used to raise a second derrick with its 60-ft. boom. Heavy I beams, tower steel, pylon and antenna were raised by the 2 derricks from street level to the 9th floor roof and from there to the new 37th floor.

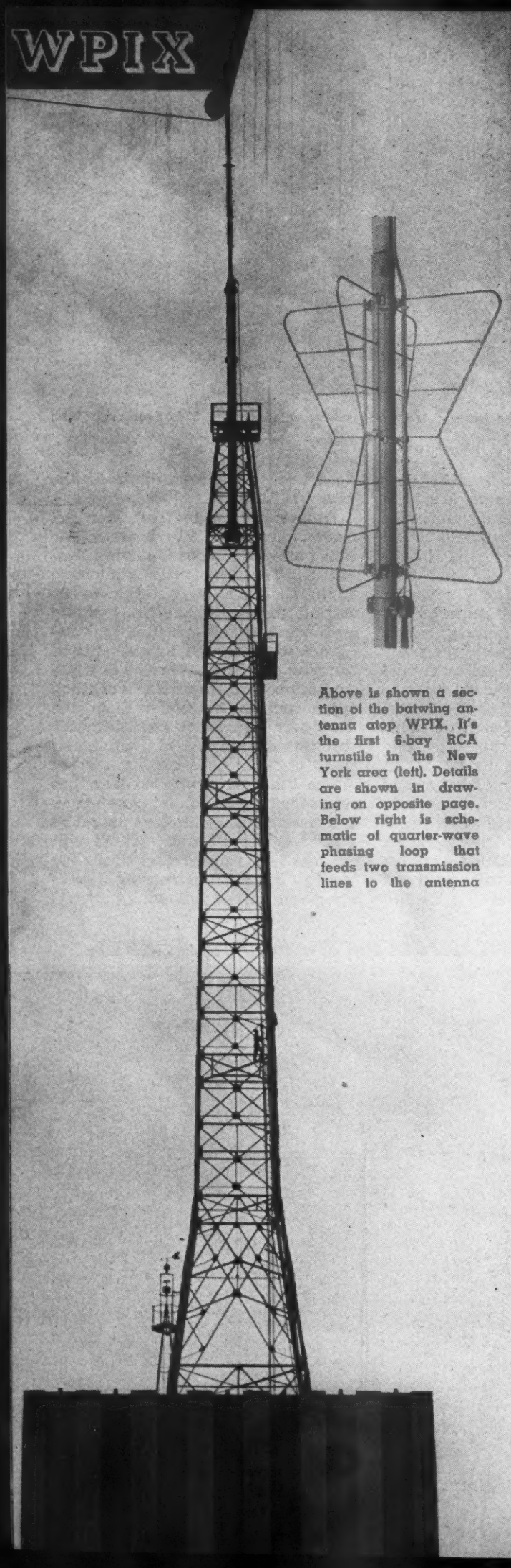
As pointed out by Tom Howard, chief engineer of WPIX, use of the News building imposed certain limitations. The transmitter is removed from the rest of the station by 27 stories; the size of the No. 1 studio and size and location of other facilities were liimted by the area of the new structure. Because of these limitations, for instance, workshop space had to be taken from the master control room area, with the result that both are of a minimum size.

The 9th floor roof, however, has space for an additional structure, in the planning stage, to accommodate a second, larger studio which will eventually permit greater operating facility. Specific engineering details are given on the following pages.

View from inside the new studio construction area, taken from studio control room

ANTENNA & TOWER

INSTALLATION • OPERATION

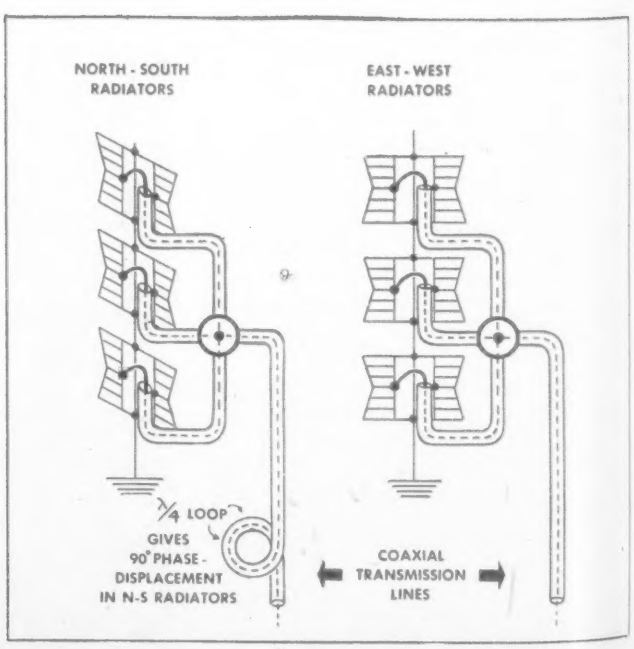


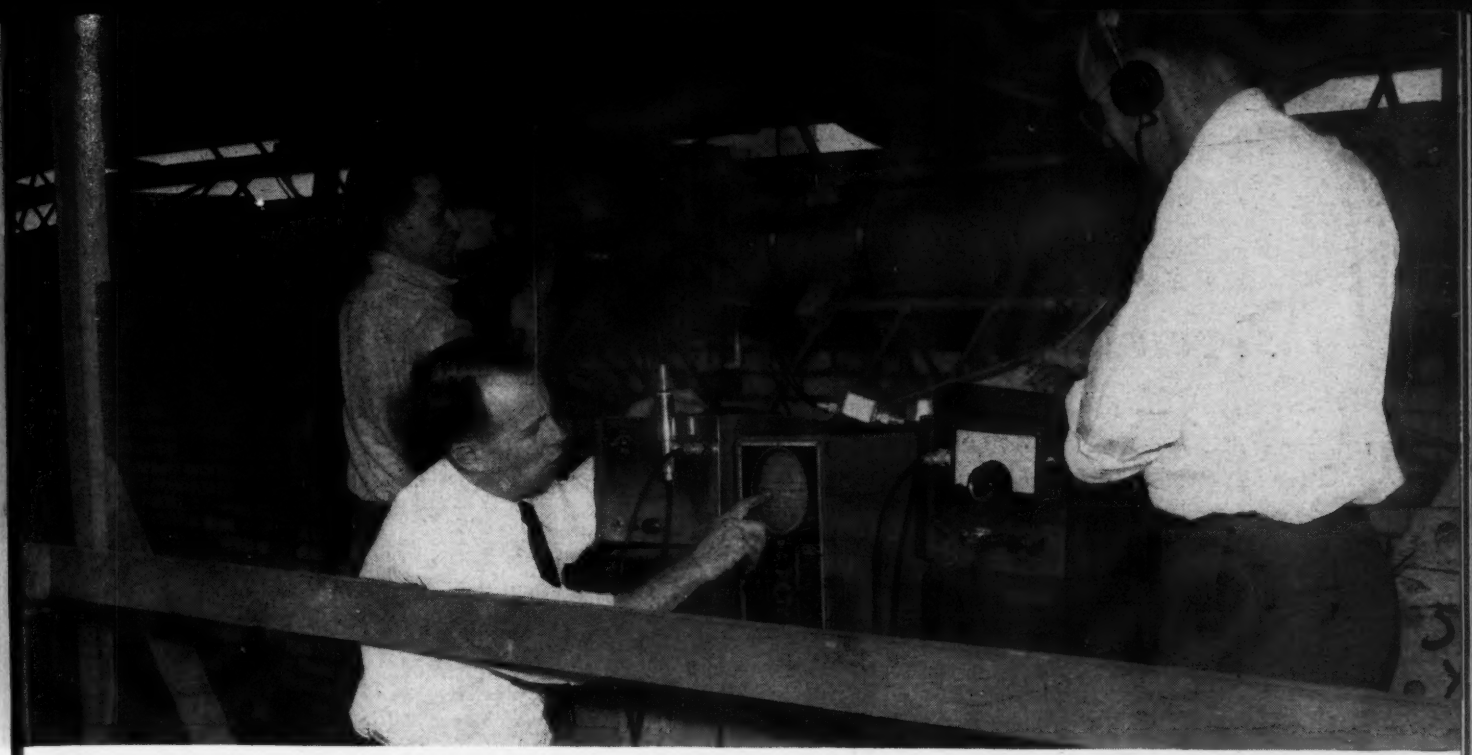
Above is shown a section of the batwing antenna atop WPIX. It's the first 6-bay RCA turnstile in the New York area (left). Details are shown in drawing on opposite page. Below right is schematic of quarter-wave phasing loop that feeds two transmission lines to the antenna

A 3-story parapet extending above the 36th floor of the News building facilitated construction of the transmitter room with its associated tower and antenna assembly. The room was built inside the parapet, and ready access to the steel building columns permitted the tower base support-structure to be located directly above it.

The support-structure is a steel grill base made up of I beams that vary from 2 to 3 ft. in depth. In most cases the existing building columns were found strong enough to withstand the load of the new tower. Two of the columns were reinforced with steel and concrete on some of the lower floors. Getting the steel and construction supplies for the tower to the site on the roof, approximately 500 ft. above the ground, was a major operation as previously described.

The tower itself, built by the White Plains Iron Works, is a square type of structure, 30 ft. wide at the base, and tapering in three stages to a 5-ft. platform where the pylon antenna and dummy plyon are attached. Tower and antenna are built to withstand a windload of 30 lbs. per square foot on flat members and 20 lbs, on round members, or an 85-mile-an-hour wind when the structure is coated with ½ in.


NORTH - SOUTH RADIATORS
EAST - WEST RADIATORS
¼ LOOP GIVES 90° PHASE - DISPLACEMENT IN N-S RADIATORS
COAXIAL TRANSMISSION LINES



RCA engineers shown testing antenna atop WPIX roof prior to installation. Details of tower and antenna construction shown below right

of ice. The weight of the tower and antenna assembly is approximately 30 tons. The super turnstile antenna, mounted on top of two 14-ft. pylon sections, is 45 ft. high. Considering the height of the tower and the height of the pylon, the antenna is 273 ft. above the building, 754 ft. above the street and 796 ft. above sea level. Although pylon antennas are ordinarily used for FM broadcasting, no electrical connections to it have been made since its function in this installation is only to add height to the television antenna assembly.

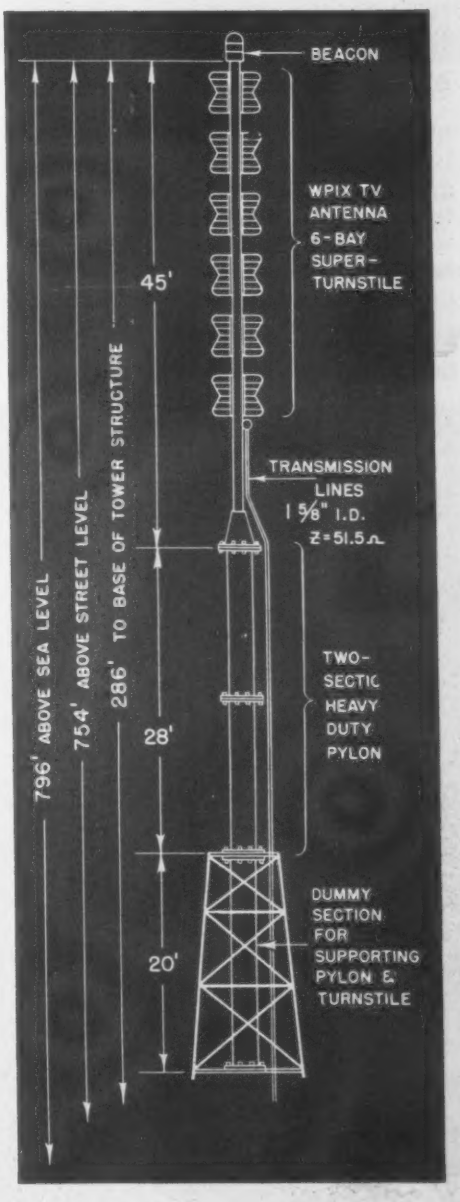
The RCA 6-bay, batwing, turnstile antenna uses 6 identical radiating sections. Each section consists of 4 batwing-shaped radiators mounted at 90° intervals around the supporting steel pole. The individual sections are mounted approximately one-half wavelength apart, center to center, and the radiators are attached to the pole at the top and bottom. The entire structure therefore is effectively grounded for lightning protection.

For identification, the 2 pairs of radiators at right angles in each section of the antenna are termed north-south and east-west radiators. Two transmission lines feed the elements in each section, and the feed for the north-south radiators is 90° out of phase with east-west energy supply. This results in an almost circular horizontal radiation pattern.

The antenna is connected to the diplexer unit in the transmitter room through a 295-ft. section of coaxial transmission line. This line delivers 2.68 kw of visual power to the antenna and has an efficiency of 79.5%. The effective radiated power of the antenna is 18.5 kw and, consequently, the antenna itself provides a gain of 6.9. Accompanying FM sound provides an antenna input of 1.34 kw and becomes an effective radiated power of 9.25 kw.

The diplexer, combines both transmitters into the one radiating system. In combining these signals the problem is to transfer the output of both transmitters to the antenna and not to each other. The aural power is fed, single ended, through a balanced network to both antenna feed lines. The visual power is applied to a crossfeed at points having equal impedance to ground. Hence if the balance is perfect there is no exchange of energy between the transmitters.

In order to melt sleet and ice formations on the antenna in winter weather, each radiator of the antenna encloses a resistance heating element. These elements are confined to the vertical tubings of each radiator and consume 250 watts of power each when in operation. An 8-kw power source has been made available to provide antenna lighting and de-icing requirements. At the tip of the antenna structure a 300 code lighting beacon has been installed. This light is presently controlled from the control console in the transmitter room, although at a later date it will be operated automatically by a photo-electric control.



WPIX

TRANSMITTER

SPECIFICATIONS • INSTALLATION • OPERATION

THE RCA type TT5A transmitter selected by the N. Y. Daily News station WPIX can deliver 5 kw (peak) video power and 2.5 kw of sound signal (frequency-modulated) to the antenna transmission line. Antenna gain will boost final video output to approximately 18.5 kw. In spite of the differences in power and the vastly different types of modulation, the 2 transmitters have many similar parts; such as supplies, similar types of tubes, cabinets, etc. The design rules for the equipment and the way it is assembled follow the same practices used in modern standard AM and FM broadcast transmitters.

The visual signal portion of the transmitter uses high level modulation. The signal is applied to the grid of an RCA 8D21 water-cooled tetrode which is mounted in a horizontal position. This well known tube, which has been applied in many UHF transmitter designs of late, is an internally neutralized push-pull tetrode of unique design. It has unusual operating characteristics at high frequencies because the use of small, high current carrying elements all of which (except the filament) are water cooled. Seven separate pairs of water connections are provided to the 2 anodes, 2 grids, 2 screens and to the filament block.

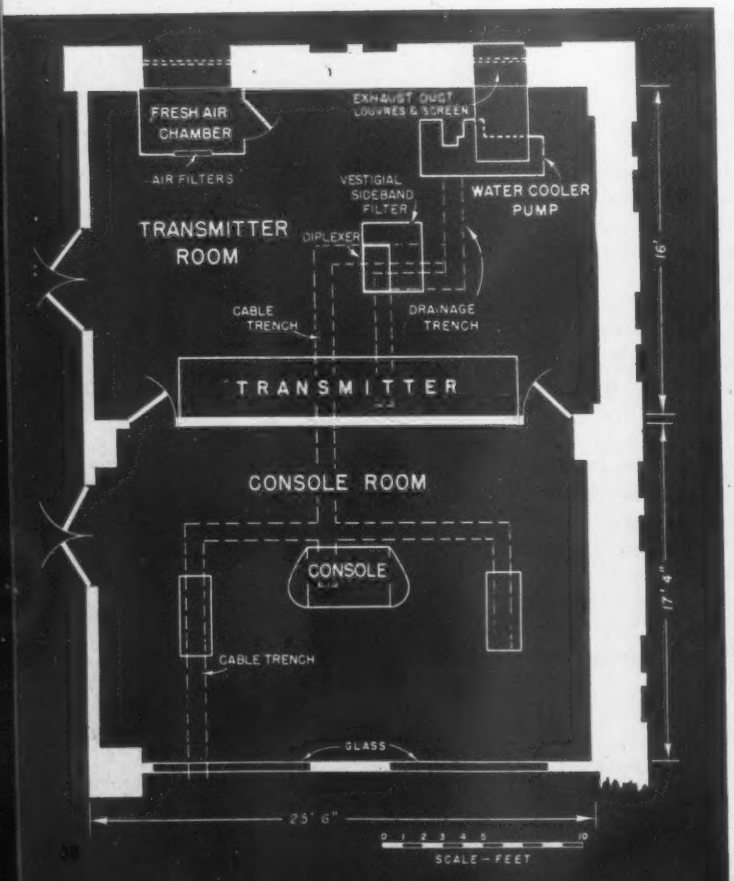
In this transmitter the tube is used as a class C grid modulated, push-pull power amplifies, with a possible plate dissipation of 6 kw. A 5-kv anode supply and 800-volt regulated screen supply is provided. The former uses a 3-phase full wave circuit with 6 RCA 8008 tubes. The 800-volt screen supply is a single phase full-wave system with 2 RCA 816 tubes. A 1.5-kv source also from a 3-phase supply, provides power for the plates and screens of the oscillator, drivers, frequency multipliers, etc.

The multiplicity of water connections would make a tedious operation out of changing a tube when necessary. To overcome this difficulty of changing tubes in case of failure during programs, the 8D21's are mounted on removal plates. Ten water connections to the header end of the tube can be made in advance on a spare tube mounting plate. Then a water connector block was developed which clamped to the outside of each anode lead leaving the ends of the anodes free for rf connections.

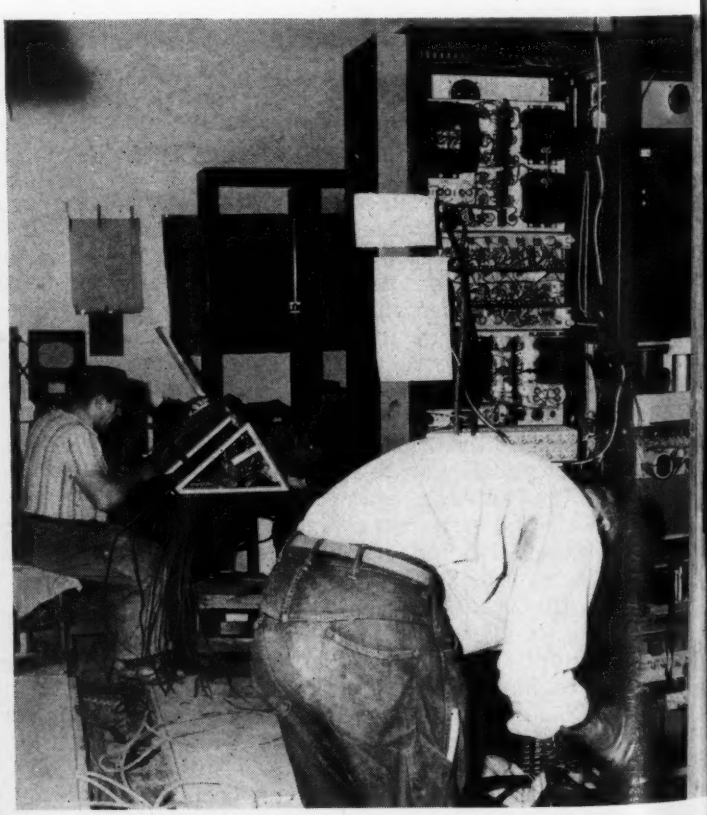
The anode cooling water from the anode tank coil flows through short semi-flexible loops of Saran tubing to the water connector blocks. RF connections clamp to the ends of the anodes, and by short flexible straps to the anode tank coil.

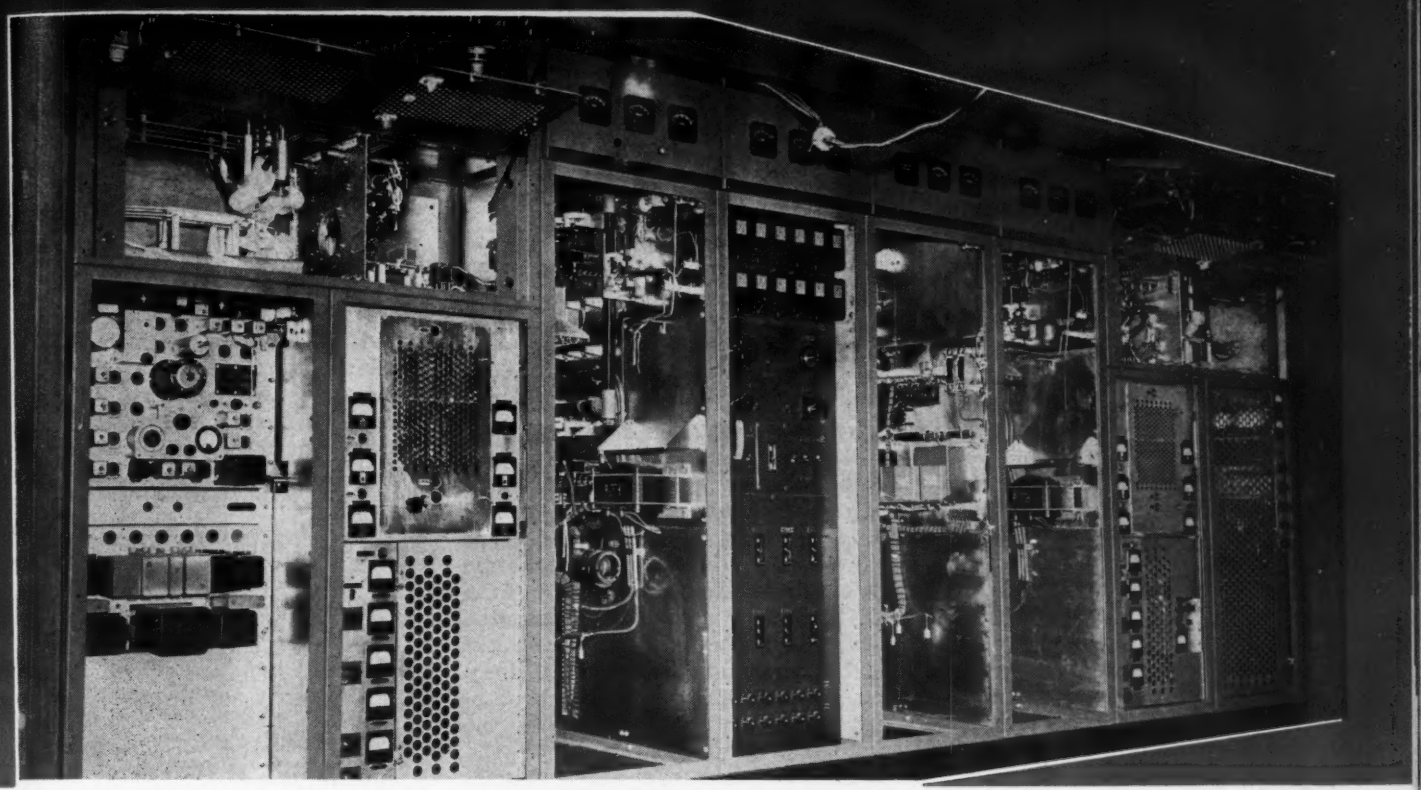
The cooling water flows through the grids and filament blocks in series. Three water circuits on the

Floor plan of transmitter room showing location of RCA equipment



RCA engineers shown installing transmitter equipment and console





RCA type TT5A (5 kw) transmitter installed for WPIX. Diplexer and vestigial sideband filter positions shown in floor plan opposite page

header end have a 3-element water flow indicator and flow-alarm meter mounted on the tube plate. As the grids and screen grid have high voltages to ground, a length of water column is provided by winding a piece of Saran tubing into a coil, and mounting these between the input header and connecting hoses, and between the hoses and flow meter connections. The quick-disconnect fittings have internal valves to prevent water leakage when they are removed. A tube change can be made in less than 2 minutes. The tube-mounting plate will fit in either transmitter, so it is necessary to have only one spare 8D21 tube mounted.

The visual transmitter operates at a frequency of 199.25 mc for channel 11, obtained by 36-fold frequency multiplication from temperature controlled crystal source. This operating crystal has a frequency of 5,534.722 cycles. The succession of stages are: a crystal oscillator and doubler—RCA 1614 pentode; a pentode doubler and then a tripler, both RCA 4E27 tubes; a push-pull tripler stage using 2 RCA 4D21 tubes. Two rf amplifier stages follow operating at the carrier frequency, the first using 2 RCA 4D21 tetrodes and the second 2 RCA 4C33 triodes. This latter triode stage is cathode excited and the triodes give enough driver power to excite the final power amplifier stage, the above mentioned 8D21 tetrode. All stages operating at the carrier frequency have tuned-line elements.

Vestigial sideband transmission is

(*Please turn to next page*)

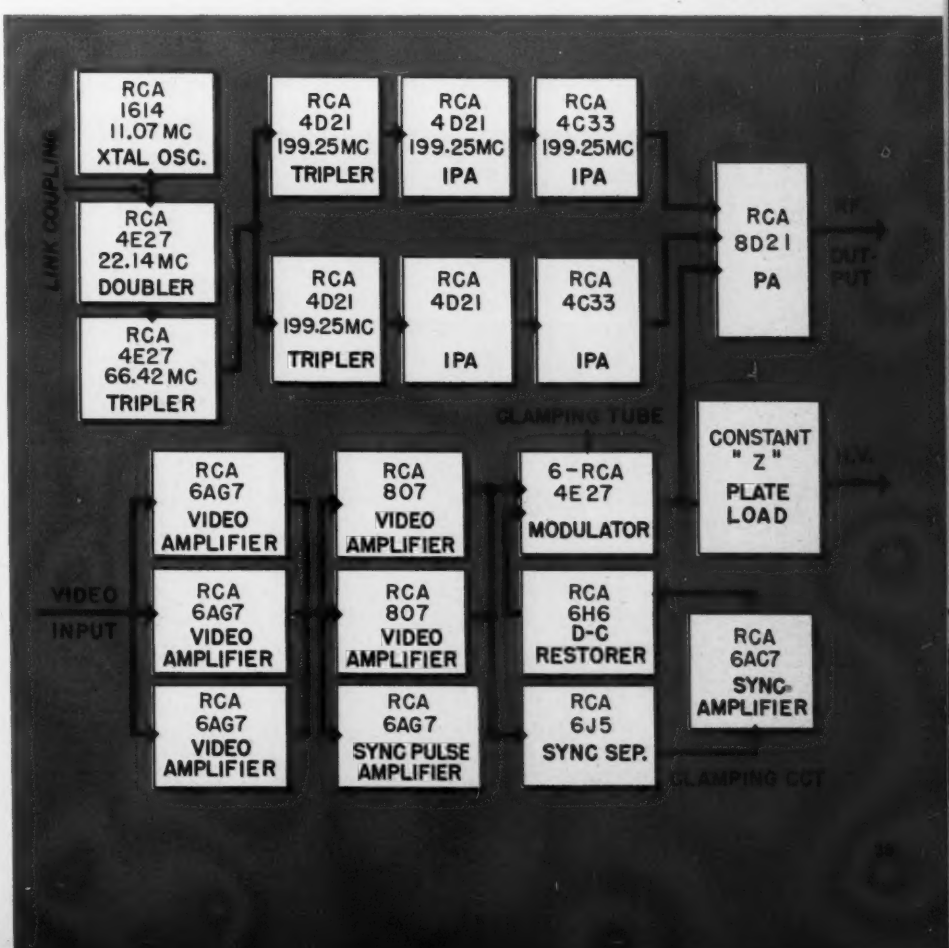


Diagram showing transmitter video amplifier, modulator, oscillator and output stages

TRANSMITTER (Continued)

achieved in the TT5A by direct suppression at high power levels in an absorption filter turned to the lower sideband. This unit extracts the undesired portion of the signal and delivers it to a forced draft-cooled resistance where it is lost. A transmission filter, also composed of resonant lines is added to shape the resulting power-frequency curve to correspond to FCC requirements.

Thus it is seen that in the entire transmitter only the final power amplifier has to handle the whole visual frequency range, and hence is the only stage that needs special attention as to its band width. The latter is helped by having the plate tank circuit not tuned exactly to the carrier but to a point about 1.6 mc above that frequency. This puts the entire lower sideband further out of tune. The reduced sideband energy is more easily suppressed thereby. Also the tank circuit tuning is about centered on the radiated band, which eases up on the required band pass characteristics of this stage. For this tuning job, a second crystal is switched in, having a frequency of 5,579.861 cycles which with the 36:1 multiplication gives a test frequency of about 200.86 mc. When the final tank circuit and antenna systems are set for this frequency, the original crystal is switched in again.

The visual amplifier and modulator unit consists of 2 video amplifier stages, 3 paralleled 6AG7 tubes in the first and two 807's plus a 6AG7 all in parallel in the second, the modulator stage with 6 RCA 4E27 tubes paralleled, a sync expander, sync separator, sync amplifier and a dc insertion diode. The gain of the video amplifier of about 600 overrides any effects of voltage variation, power hum, etc.

Each video amplifier stage is provided with a high-frequency compensating network. To compensate for the loss in sync-pulse amplitude in the succeeding modulator and power amplifier stages, an RCA 6AG7 tube is connected in parallel with the 807s. As the 6AG7 has high transconductance (and sharp cut-off), it expands the synchronizing pulse without increasing the amplitude of the picture signal. The modulator plate load is a constant-resistance network which maintains an impedance of 500 ohms over the entire video band.

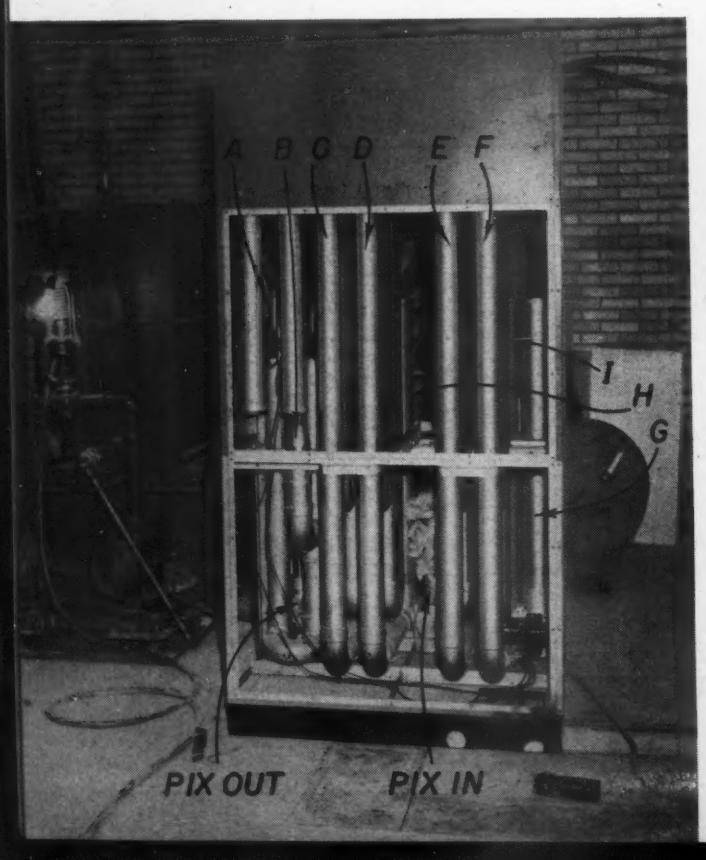
A "clamp" type dc restorer circuit is used in the modulator stage. This circuit, which employs a sync separator (RCA 6J5), a sync amplifier-inverter (RCA 6AC7) and a biasing and restorer tube (RCA 6H6), partially disables the modulator tubes during the last part of the horizontal blanking signal immediately after the sync interval to reduce spurious low-frequency signals.

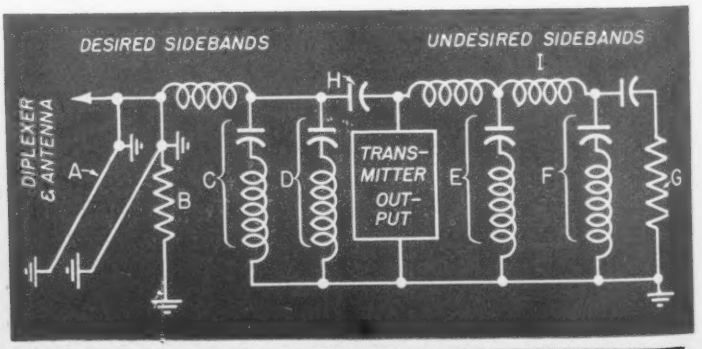
The center of all transmitter control operations is the monitoring console. The efficiency is improved and the operation of the transmitter is simplified by having most of the operations performed from this central control point where complete monitoring facilities are provided. In the console are the essential starting and stopping switches, gain controls, indicator lamps and output meters for transmitter operation, plus complete monitoring facilities for both picture and sound signals. Spare push-button switches permit remote picture and sound monitors which are connected in wherever needed.

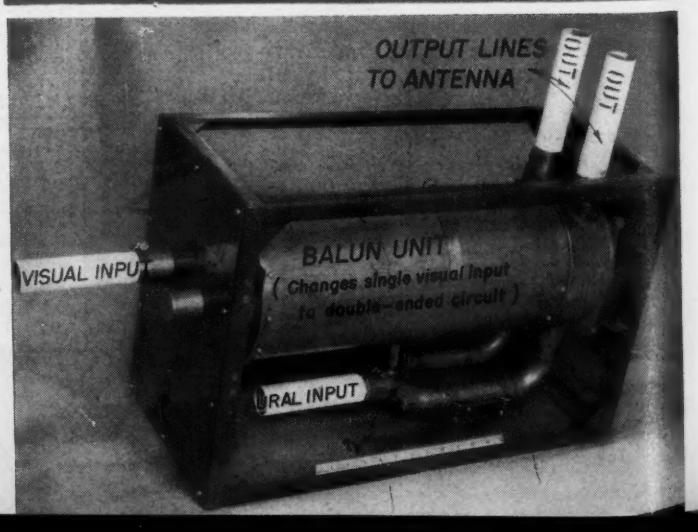
The sound signal is monitored by a VU meter and built-in speaker. The monitoring speaker as well as the VU meter can be switched by push-buttons to either the input or the output of the audio channel.

The output of the sound transmitter is fed to a diplexing unit through a 3⅛-in., 72-ohm coaxial transmission line. The picture transmitter output is similarly connected through the vestigial sideband filter. The diplexer, a coaxial-line type of coupler, feeds two 1⅝ in., 51.5-ohm transmission lines, one of which has a quarterwave delay section in it so as to feed adjacent wings of the turnstiles in proper phase.

Vestigial sideband filter (L); circuit diagram with elements identified by letters corresponding to those on photo; diplexer unit below right







STUDIO CONTROL

EQUIPMENT • OPERATION

THE studio control room is located at one end of the studio and is at a level high enough above the floor to permit as full a view of the interior as possible and yet low enough to insure that any activity or any equipment on the catwalk in the studio will not obstruct viewing the performance below. The control room is divided into two levels to facilitate the operations of technical and program personnel. The floor plan shows the location of RCA equipment that will be installed in the studio control room. Pickup operations of this equipment differs from remote operation in that the camera sync and deflection signals are obtained from waveform generators in the master control room, and the audio installations are of a permanent nature rather than consisting of portable units.

Since RCA field cameras temporarily being used in the studio have image orthicon tubes, they are highly sensitive at very low light levels and are able to handle wide ranges of light intensities. Electronic viewfinders are used on each of the 3 cameras. The output of each camera feeds a camera control unit located on the lower of the 2 levels of the studio control room.

The technical director operating the studio switcher on the raised dais behind the monitor units chooses the desired picture from the pictures appearing on the kinescopes in the control units. The switching unit has facilities for instantaneous switching between any of 6 input circuits and for fading or lap dissolving between any 2 signals. The studio's picture output is seen on a master monitor unit next to the switcher as it passes to the master control room for channelling to the transmitter.

A complete audio control console, similar to the type used in regular FM broadcast service is used for controlling accompanying sound. A video rack and an audio rack house the necessary amplifiers, patch panels, and power supplies to obtain studio output signals of proper level and to permit correct termination of incoming audio and video lines.

Control flexibility in the studio control room is again keynoted through the availability of a video patch panel used in conjunction with the studio switcher. External video inputs can be mixed with video originating in the studio and then passed to master control room for transmission. Currently, such circuits are provided between film projection room—master control room—studio No. 1; and between remote pickup point—master control room—studio No. 1. At a later date connections between studio No. 2—master control room—studio No. 1 will be effected.

A separate room for televising news broadcasts is also provided at studio floor level. Studio equipment will be used for activities in this room and control of the equipment will be effected from the studio control room.

Studio control equipment showing: audio control consolette on right; master picture monitor, center; studio switching unit on left. On lower level in front are 3 camera control units (temporary installation). Equipment is RCA. Floor plan shown above

WPIX

MASTER CONTROL

DESIGN • INSTALLATION • ENGINEERING

A television station required to handle programs from the many sources planned for WPIX required an unusually complex control system. Organization of the control operation was determined by WPIX engineers under direction of chief engineer Thomas E. Howard with the assistance of William Sloat, in charge of engineering and Otis Freeman, in charge of operations.

A plan-view (racks) of the major items in the control room is illustrated below. Here, in the center, a group of console desks provide complete switching and monitoring of both sight and sound signals. At present, the programs may originate in the main studio, a second studio (which will follow later), or at one of a group of 16 and 35 mm cameras, from a 2 x 2-in. slide projector that permits simple changes of tests pattern, or via remote pickups as received over radio relay links or over N. Y. Telephone Company's video lines, or later from the special Baloptican still-projector now being built to WPIX requirements.

In addition, complete interphone communication facilities are at the operator's finger-tips. Much of the apparent circuit and equipment complexity stems from the desire to provide simple operation.

A short description of a few of the possibilities may be of interest. Suppose that a film camera is to be used. Referring to the plan-view, one may consider the waveform rack No. 1 and its duplicate or auxiliary No 2. Each of these racks are a source of the synchronizing signals, obtained from the RCA pulse shaping panel. The latter produces all the waveforms necessary to obtain the RMA standard synchronizing signal, a combination of several pulses at 15,750-cycle and 60-cycle recurring rates. The 60-cycle frequency is obtained by subdivision circuits from the 31.5 kc oscillator. As usual, these frequencies are interlocked with each other.

The circuits also contain provision for checking the derived 60-cycle framing frequency against the power line equivalent, with tie-in circuits that automatically alter the master oscillator frequency if a difference is noted. This is done by an AFC circuit and locks the whole television system, if desired, to the local power line frequency to minimize the effect of hum in receivers.

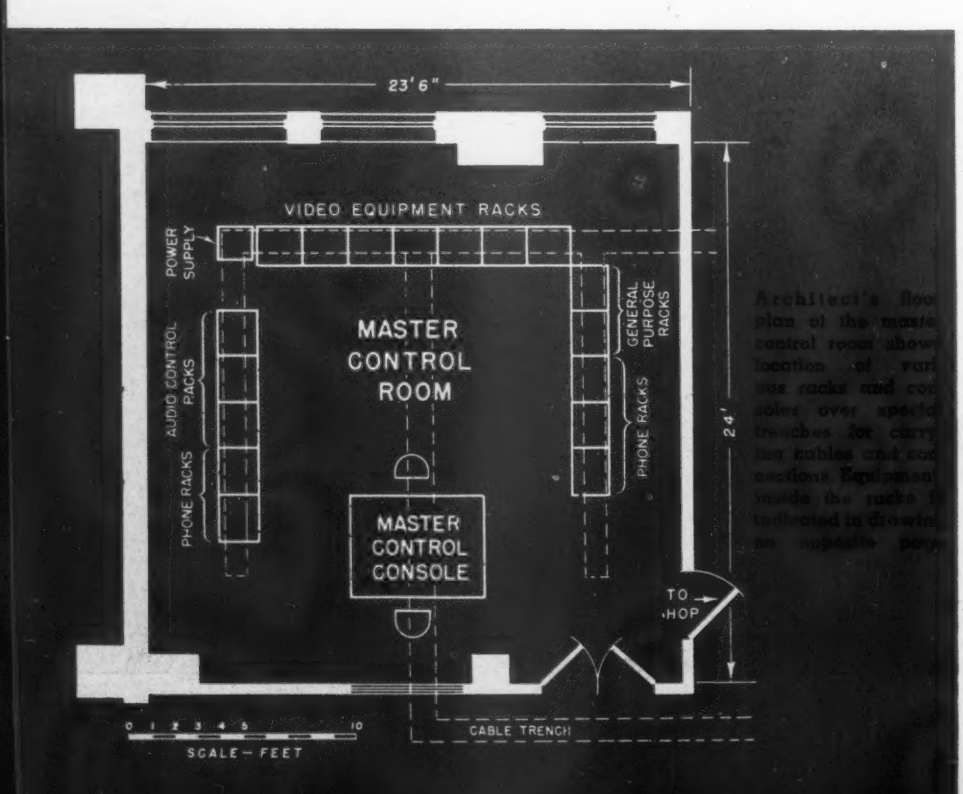
Some of the individual components of the composite sync signal have a habit of being needed at many points in a television system so that the following signals are made available for use where needed: Sync signal (plus and neg), H and V frequencies (plus and neg.), H_1 and V_1 (plus and neg), pedestal (plus and neg).

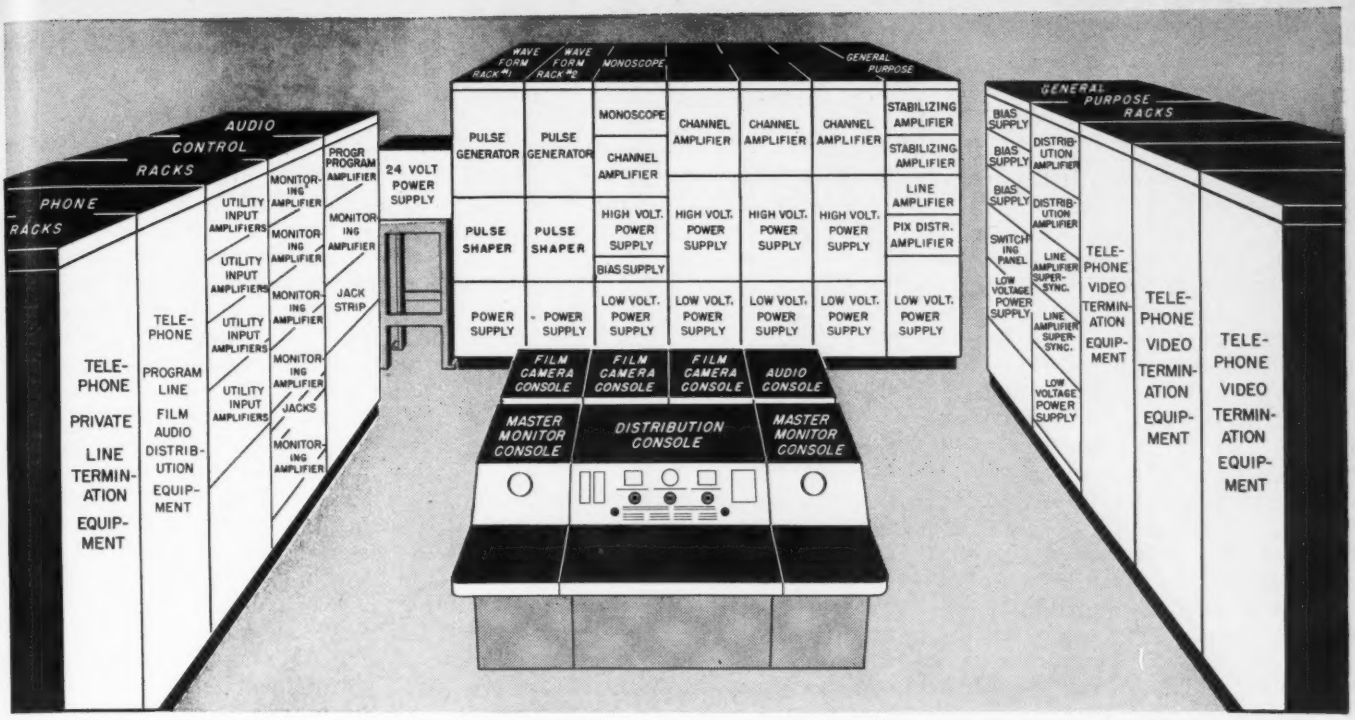
The 2 waveform racks can be alternated in use by complete automatic switching facilities from distribution control.

The film cameras use iconoscope tubes which require correction for unequal output from various points on the mosaic. This is done by changing the amplifier gain at various spots in the scanning interval during each field. For shading correction 4 signals are made available to the operator at the monitor console: 2 having sawtooth waveforms and operating at horizontal and vertical scanning frequencies. The other 2 shading signals have a parabolic waveform contour. Selected combinations of these signals are mixed and the resulting composite is applied to an amplification control point in a video amplifier. These shading controls may require frequent readjustment by shading control monitoring operators.

Adjacent to the waveform racks is a monoscope rack consisting essentially of three parts: the video amplifier, the sweep generator and the blanking amplifier. Six other cabinets carry general purpose and incidental equipment panels such as various distribution amplifiers for house monitors, line amplifiers, low power and heavy-duty B power supplies and bias power supplies.

Three more cabinets are devoted to the incoming telephone video cable terminating equipment and





Arrangement of racks and the nature of the equipment in each are shown in the above schematic of the master control room layout

their video distribution amplifiers. In the opposite bay other racks carry the associated telephone audio program lines, and booster amplifiers for incoming audio signals, intercommunications system equipment, etc. Talk-back facilities are complete between operating points where extremely close coordination with the control room is needed, as between the projection room and the studio control room.

At the master control point 2 master monitor consoles flank the distribution console, to form the master control desk. These consoles provide simultaneous display of the picture and waveforms for any of 17 picture signals. A push-button interlocking switching system controls video input and 8 interlocked push-buttons control audio program switching. Indicating lights connected with each of the push-buttons indicate which channel is being used. All video signals to the monitors are 0.2 volts peak-to-peak, black negative on a 75-ohm coaxial feed.

The GE distribution console is the master control point for both video and audio of a multi-studio television system. It contains circuits and controls necessary to handle a series of programs from studios, remotes, and networks. In addition to the program circuits, versatile communication circuits to the points of control are provided. The operator handles only the output signals from each point of origin and has, for instance, no control over the selection of particular cameras in any studio. The latter is handled by studio control facilities described later.

Etched plates, replaceable titles and fluorescent titles adequately tag all controls on this console. A clock with a second hand and resetting switch helps the operator in his timing. The console also contains all necessary talk back and interphone facilities.

The transition from one program source to another must be achieved with smoothness, so that timing is all important. Facilities permit switching, mixing or fading of any studio source as well as lap-dissolving if desired. Also available are by-pass circuits that permit switching of any studio source directly to the program line, thus avoiding the circuits connected with mixing, fading ,etc.

The video controls at present provide the means for switching, fading, or lap-dissolving between 6 program sources. The actual transfer of connections is by relays switched by the use of push buttons located in 2 groups, A and B. Each channel has an "available" light

(*Please turn to next page*)

GE master monitors are shown with distribution console in the center. Film camera consoles back it up

MASTER CONTROL (Continued)

(white), a "preview" light (green), and a "program" light (red).

These are an important part of smooth program handling where rapid change of scenes and the location of the picture source is continually necessary. In the case at hand, a choice of 5 alternate program sources is open to the operator when a particular part is approaching its climax. Of the 6 circuits, those that are set up and ready for use are indicated by the "available" light. In the case of a camera, for instance, this light comes on only when the camera tubes' high voltage circuits are energized and the deflection yoke currents are flowing.

The "preview" light serves as a signal to all interested personnel at any point that that particular channel is about to go on the air, to alert the camera and channel operators, talent signals, etc. When the channel is accepted the preview light drops out and the program light appears at all signal points.

The above mentioned 2 rows of switch banks A and B are interlocked so that if a channel is already selected on one bank it cannot be selected from the other.

Cross-interlocking between channels on the same bank is provided so that if switching only is desired, it may be accomplished in either switch bank by first operating one channel button, then, in turn, any of the remaining channel buttons, thereby automatically dropping out the previous channel.

The mixer amplifier combines and amplifies 2 signals; that is, one from a film camera and one from the studio for fading and dissolving.

An additional by-pass circuit and control provides means for circumventing this lap-dissolve and mixer amplifier, to permit, for example, one studio to be on the air while another is having a full rehearsal. The by-pass circuits allow any channel to be routed around the switch banks and the mixer amplifiers, or the switch banks operation continues by switching through the by-pass circuits.

The actual switching of the video-signal circuits is done with special low-capacitance video relays located in the console and controlled by 2 sets of push buttons on the top of the console. Special relay contacts supported on insulation avoid electrical capacitance-to-ground as well as between contacts so that fidelity requirements are more easily maintained. There are 2 sets of 6 relays to each control group capable of connecting any one of the 6 channels to one of the 2 fader potentiometers. Pressing a particular button causes its relay to pickup and hold in. Simultaneously, any other closed relay in that set drops out.

Lap-dissolve or fading is accomplished by lever-action, mechanically interlocked variable attenuators which are connected to each input of the mixer amplifier. When one lever is pulled forward, the other recedes to the rear position, bringing one signal in and fading the other out. If, for instance, a particular channel is feeding through the left bank of relays to fader A and it is desired to fade down to black and up on another channel, the new channel is preset on the right bank by pushing the proper button. At the chosen time, fader A is reduced and fader B advanced after the first has been brought to zero.

An alternate method which does not require a preset, is to fade the outgoing channel down to zero, pick up the desired channel on the same bank of relays by operating the proper selector switch, and fade up the new channel with the same control. To accomplish a lap dissolve, the same preset is made before moving the fader up. This reduces the other fader at the same rate, causing the old picture to dissolve into the new one. Quick switching is accomplished simply by selecting a new circuit and pushing the desired button associated with the same set of relays. A release button in each bank of relays cancels presets when necessary.

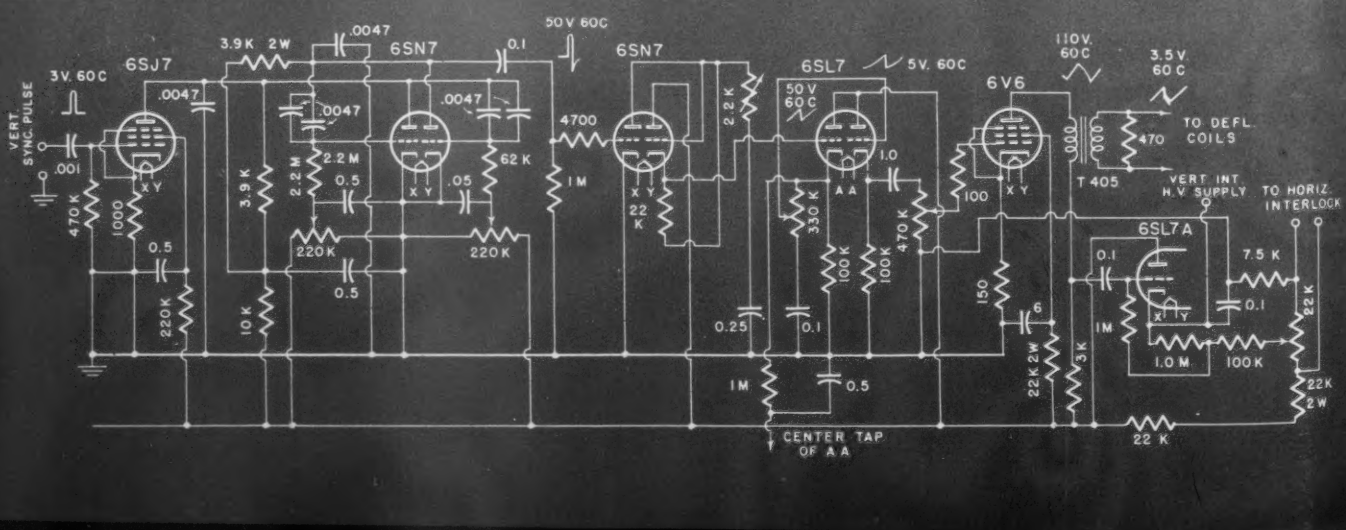
A pulse generator selection control permits arbitrary and remote selection of the program pulse generator or the standby pulse generator. A phasing control allows the station pulse generators to be phased with any incoming program, thus permitting the remote program to be switched to a local program without causing the receivers to lose frame while their circuits lock into the new scanning rate.

Additional features provide an adjustment for maintaining the correct synchronizing pulse height, and a pulse generator selector, with indicating circuits, in order that the alternate source of station frequency standards may be used.

The master control operator can monitor 2 program sources at the master monitor consoles at each side of the central position. These contain a 10-in. picture monitor tube and a 5-in. waveform monitor tube. The latter has circuits to allow operation from either a composite picture signal or separate picture and sync signals.

Continuous picture monitoring of

Circuit schematic of monoscope vertical sweep generator which provides mixed sawtooth and parabolic waveforms to deflection coil

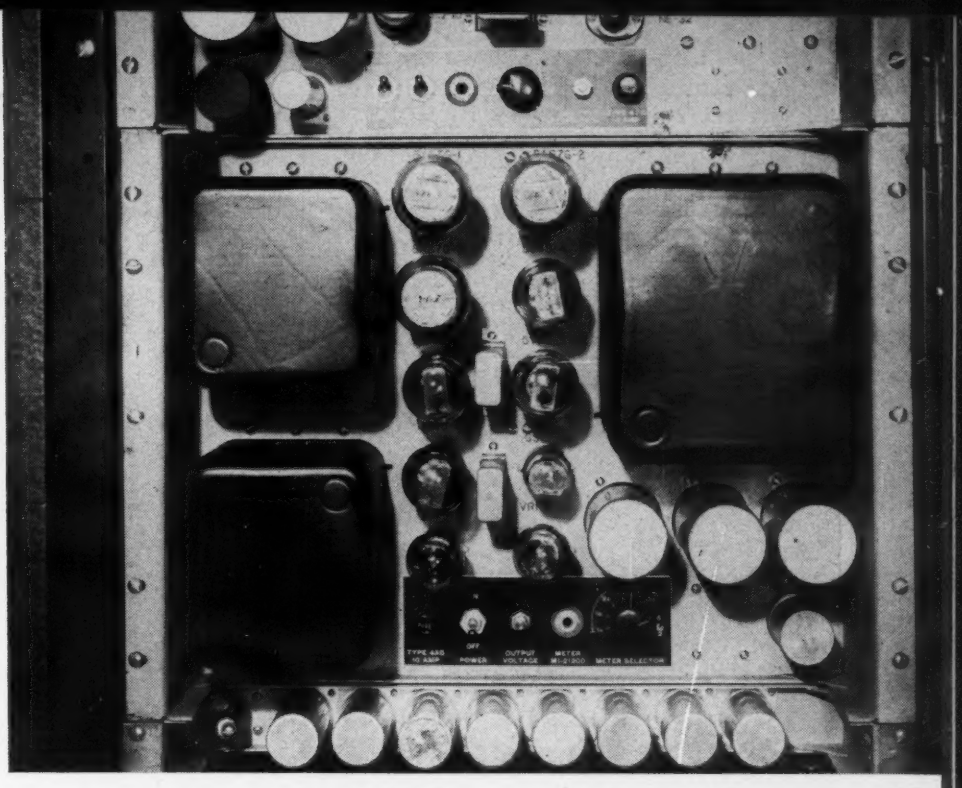


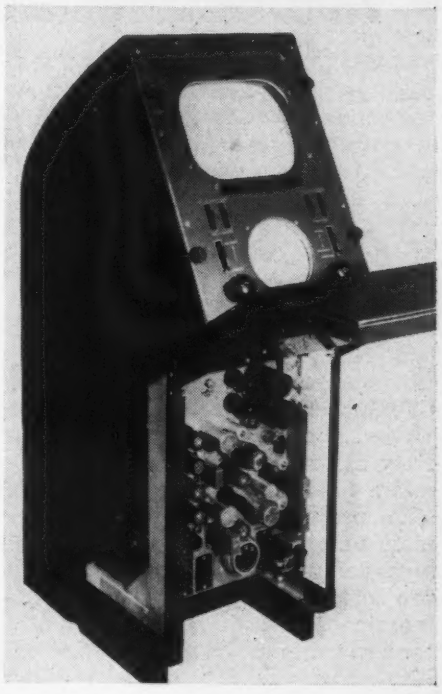
the program being transmitted is handled on one monitor while the second is employed for cueing purposes or for monitoring various points of the system as desired.

The switching facilities on each of these monitors are such that a view of any of 5 possible studio sources may be selected, or of the monoscope output, the network, NEMO No. 1 or No. 2, program output, and any special lines as desired. All these sources may be viewed independently of the settings of the adjacent master distribution console. All monitors use 10DP4 and 5CP1 viewing tubes.

Three RCA film camera control consoles are mounted back to back with the master control desk. A typical control desk console will vary in some details depending on whether an iconoscope, image orthicon or monoscope is handled. The camera control console consists of a channel monitor in addition to all controls and adjustments necessary for proper camera tube operation.

This film camera monitoring point is one of the major points of control in a television system since the quality of the transmitted pictures depends on the diligence of the monitoring operator. Among the various adjustments which are made at this point are shading, camera deflection centering, camera electrical focus, iconoscope bias, as well as channel output level and reference of the signal-to-black level. The signal, having been inspected at this point, is then available for switching or fading at the program console. Each camera channel is monitored continuously. Studio cameras are controlled by simliar equipment in the studio control booths.





Above: Type WP33A heavy duty regulated power supply furnishes dc voltages to video amplifier and to camera control units. Right: Type TK 20-A, RCA film camera control. Camera control chassis in lower compartment has video amplifier and driving circuits for the pickup tube in the camera. Details in text

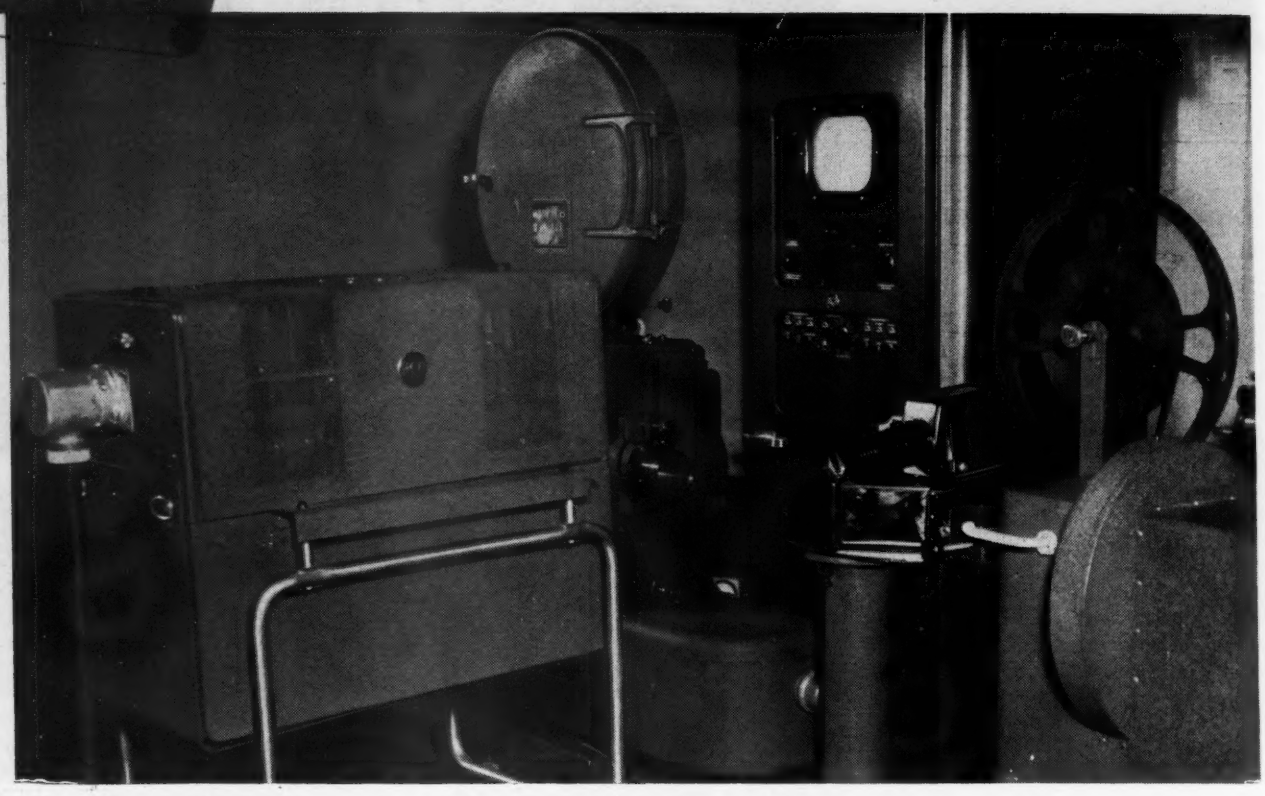
Monoscope Operation

The monoscope delivers a complete picture signal in the form of a constant never-changing pattern used for test purposes. The output is similar to that of a camera channel. This unit provides the simplest source of a picture signal and releases a regular film or studio camera for other purposes. Its output can be routed around or switched on the air in the same manner as a camera channel but needs no continuous controlling or monitoring. It delivers a standard 0.2-volt video signal of correct polarity, complete with blanking.

The monoscope contains its own sweep generator. Horizontal and vertical pulses from the pulse generator are differentiated and amplified through buffer tubes to trigger multivibrator circuits. The latter contain the controls for varying the sweep-speed and the pulse-width adjustment to set the retrace time. These are followed by integrating and shaping circuits to provide linear sawtooth currents in the sweep coils. Eleven screwdriver controls adjust the horizontal-and vertical-sweep speed, width, amplitude, linearity and interlock.

The method of securing linearity of scanning is of interest. The vertical-sweep circuit begins with a sync buffer amplifier and a multivibrator which feeds adjustable-width pulses to the triode integrator. A triode constant-current tube feeds the integrator plate circuit. The integrator output consisting of sawtooth and variable pulse signals is then fed to a cathode follower which feeds a second integration circuit. A parabolic waveform is added to the sawtooth signals in suitable amounts and both are then fed from this circuit to another cathode follower which feeds an amplitude control.

The horizontal sweep circuit is similar except for the pentode integrator whose screen voltage controls the amplitude. A constant-current triode feeds the integrator and a cathode follower delivers the signal to the output stage. The output tube, 807, feeds the deflection yoke through a stepdown transformer. A potentiometer across the sweep output provides variable feedback through a network to the bottom of the integration capacitor. Proper adjustment of this linearity control provides a sawtooth deflection current waveform of good linearity.



Typical RCA 35mm (left) and 16mm (right) projector arrangement using a multiplexer (center on stand) with a single pickup camera

FILM PROJECTION

METHODS • EQUIPMENT • APPLICATION

THE film camera, film projector and slide projector afford a variety of film facilities for programming, background and fill-ins. The slide projector is a standard Eastman unit mounted so that special high-definition 2 x 2-in. slides are projected directly on the iconoscope mosaic of one of the 2 RCA film camera tubes in the projection room. A variety of slides can be stocked to cover oft repeated patterns.

In addition, a special Baloptican enlarger of photographic stills is being prepared so that a series of photographs and other opaque pictures, can be projected in rapid succession. The pictures from the reflectors of this enlarger are directed on the tube's mosaic of a third iconoscope, in the projection room.

Each of 2 projection room tubes receives pictures from 3 sources using the RCA TP-9A film multiplexer system: from the 2 x 2 slide projector mounted directly in front of the iconoscope screen, or from one or the other of the film cameras by way of a right-angled optical mirror reflector directly below the slide projector.

The mirror images reflected are directed into one of the RCA TK-20A camera units which produce the picture signal. The film camera unit uses an RCA 1850-A iconoscope. In the film camera case are the blanking and deflection amplifiers, a six-stage video preamplifier fed by the iconoscope which delivers a signal to the firm camera control and the general distribution console system.

As is now pretty well known regular commercial film projectors must be modified in several respects when used in television service — mainly because the 24 per-second framing rate of the former must be converted to what is essentially a 60 per-second framing rate. The 2 film-camera setups are independent and duplicate each other. The RCA TP-35A (35mm) film projector features (1) means for precise synchronization with the 60-cycle frequency from the pulse generator racks in the master control room; (2) speeding up of the pull-down rates of the intermittent, and (3) provides a pulsed light instead of an arc.

The projected picture has only to cover the area of the mosaic on the iconoscope. Actually a 90° reflection takes place in the optical path (a plane mirror) in order that the images from several projected sources can all be directed onto the same mosaic. Covering such a small area (16 sq. in. compared with as many square yards on a theater screen) the illumination needed is relatively modest. This permits the use of an extremely short pulse of light to charge up the mosaic.

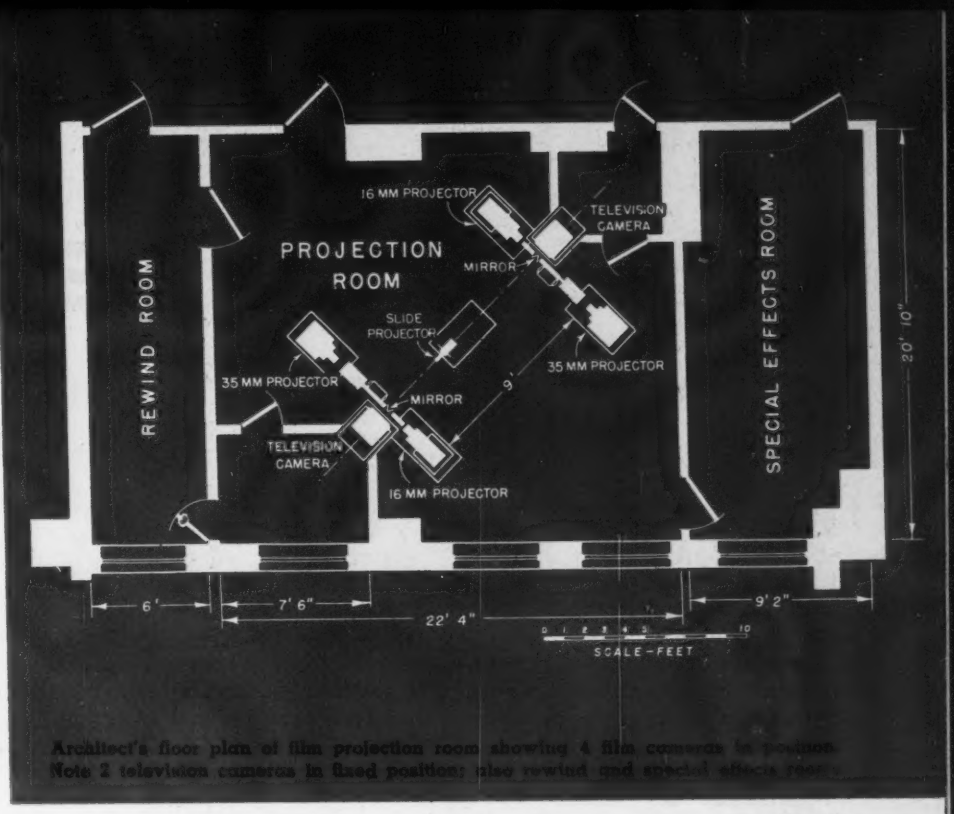
In order to obtain a complete television signal the mosaic of the film camera pickup tube must be scanned almost continuously. The only significant break is the interval in which the beam returns from the bottom of the picture to the top. During this interval—1/750th of a second, every 1/60th of a second—the picture is blanked out. Therefore, a further stratagem is

employed. This consists in the use of short light flashes so timed that the film picture is projected on the pickup tube mosaic for only 1/1200th of a second, every 1/60th of a second. These flashes occur during the vertical retrace time.

The 60 light flashes required every second are provided by a rotary shutter which consists of an 18-in. metal disc with a slot cut in its periphery. This disc is driven at a speed of exactly 3600 rpm by a special 3-phase synchronous motor. The shutter is located where the cross-section of the beam to be interrupted is small compared to the size of the shutter opening, thereby providing a quick opening and closing and a relatively long full-opening time.

The basic unit of the TP-35A equipment is the Brenkert BT90 projector head which employs a special geneva movement and other features needed to meet the standards set up for the television system. Here also the pulsed light source provides adequate light output with negligible heating of the film gate or the film itself, and makes possible a great mechanical simplification in comparison with earlier types of television film projectors.

In model TP-16A (16 mm projector) the film travel is also at the standard 24 frames - per - second rate. A rotary shutter revolving at 3600 rpm provides the 60 exposures required for televison transmission. A 3-phase synchronous motor is used to drive the shutter and to permit synchronization with the sync generator or a second projector.

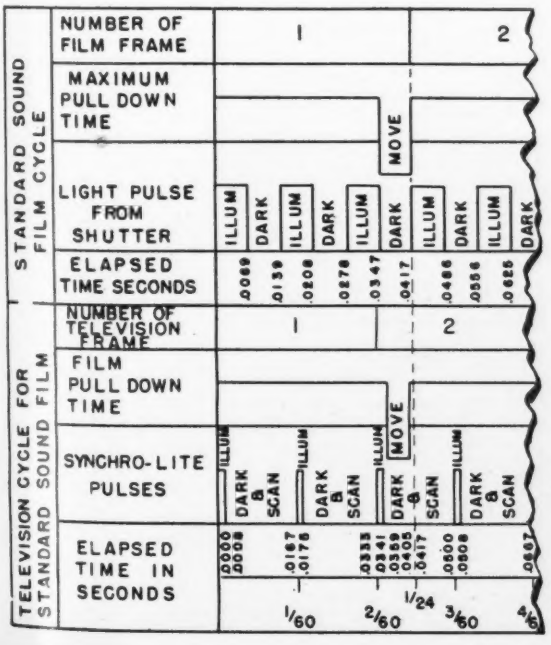


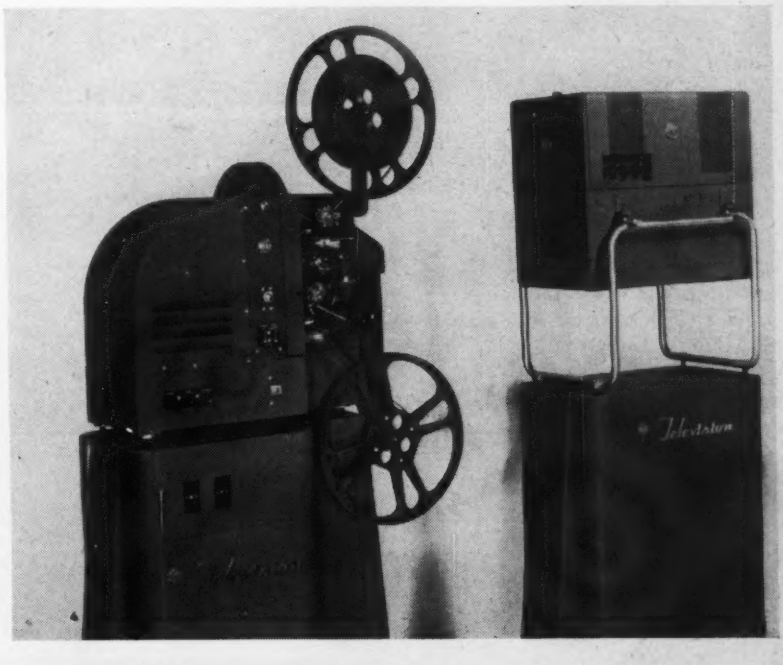
Architect's floor plan of film projection room showing 4 film cameras in position. Note 2 television cameras in fixed position; also rewind and special effects room.

Two auxiliary sources of light are useful in setting up the iconoscope. These are the "edge" and the "bias" lighting. The iconoscope tends to have edge flare due to the system of scanning and the disposition of the secondary electrons. This edge flare, which shows up as a bright band at the edge of the picture can be improved by shining a bar of light on the mosaic just outside the scanned area.

The second source of auxiliary light is the bias lamp. This lamp is placed back of the iconoscope and gives an even illumination over the rear of the tube. This changes the sensitivity of the iconoscope and reduces the application bar for movie work. In the presentation of movies the picture is flashed on the mosaic for only a short part of each cycle, giving rise to a pulse of picture signal. This signal, which is at frame frequency, may be many times greater than the video signal and hence it may set up grid current in the video amplifier. The proper amount of bias light will cancel this signal.

Drawing on left is a comparative time chart showing how synchrolite changes film speed from 24 to 30 frames per second in 35mm camera; on right is photo of RCA 16mm projector with associated iconoscope camera equipment. Details of operation are given in accompanying text





WPIX

STUDIO DESIGN

CONSTRUCTION • ACOUSTIC TREATMENT • MATERIALS

DESIGN and sound treatment for WPIX studio No. 1 was a different problem from that encountered for broadcasting and recording, and proved somewhat similar in many respects to sound conditioning for motion pictures. In television, sound and vision must match. If an outdoor scene is being shot, the sound must not be reverberant as though coming from a rain barrel; conversely, an indoor scene requires a certain amount of room acoustics to make it sound real. The first condition is achieved by covering the walls with sound absorbing material; the second condition requires the use of sets and flies for proper reverberation.

Some of the physical requirements were: a ceiling height capable of accommodating a catwalk for special lighting equipment; a ventilating system adequate to handle the increased load caused by the heat from the intense lighting; heavy wall construction for sound proofing and vibration resistance necessitating floating the studio. The problem of sound isolation had no relationship to the acoustic condition of the room itself but was a matter of construction and location. Since the WPIX studio was built over the Daily News newspaper presses, sound isolation was an important construction factor.

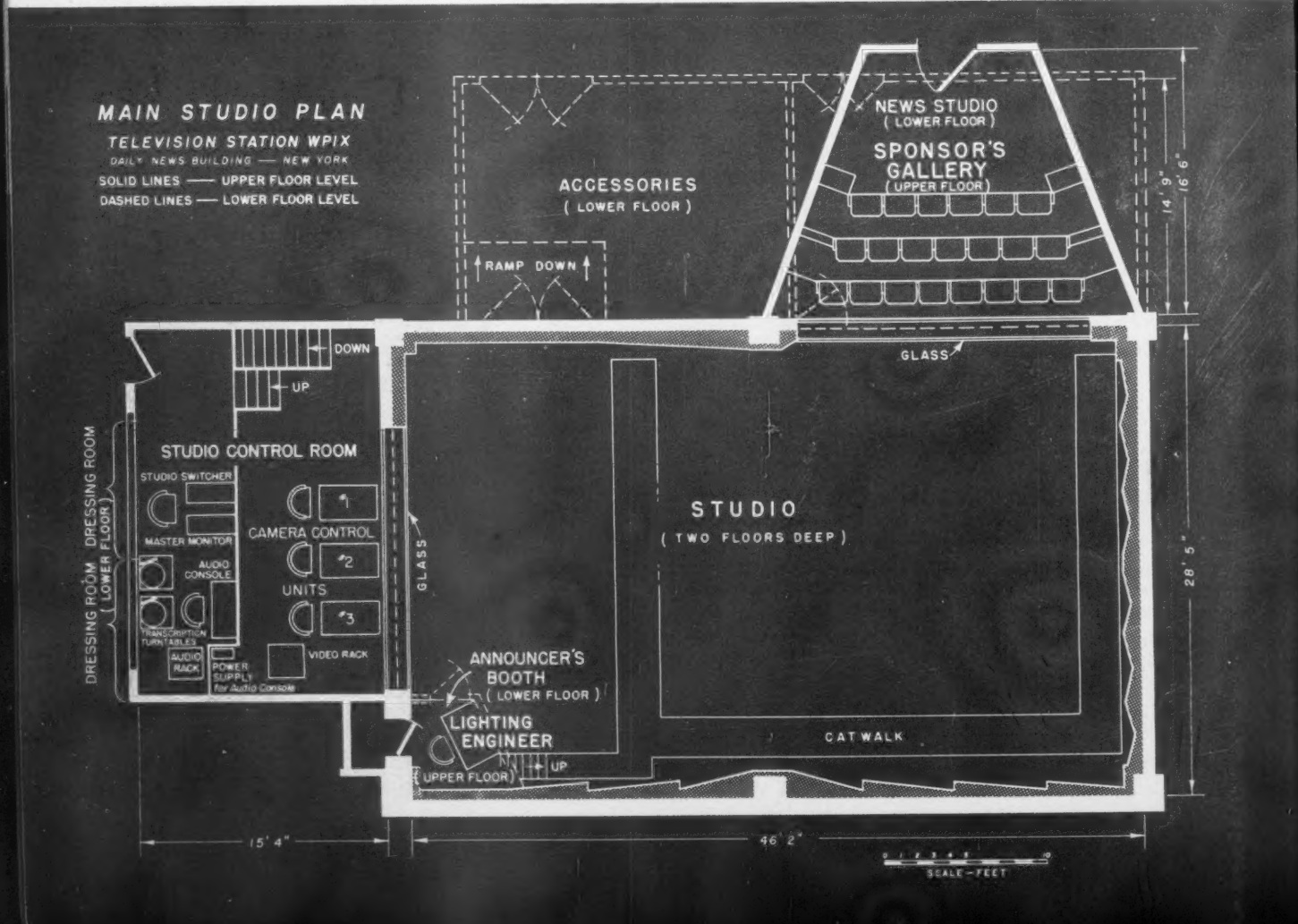
Floating of the room was accomplished by means of spring isolators which carry or support the inner room. Entrance to the room is accomplished through sound-proofed doors whose jambs are also floated in the floating room. Details of the manner in which the room was floated and treated for sound follow:

The No. 1 studio, as previously described, is part of a new construction built above the 9th floor roof directly over the News printing presses.

The studio is rectangular, approximately 28 ft. wide, 46 ft. long and 22 ft. high. The floating technic is a relatively simple one of construction engineering. It is a room within a room. The outer room is of heavy brick masonry. All sides, floor and ceiling of the masonry walls are lined with a sound isolation blanket of rock wool.

The walls of the inner room are

Floor plan of the WPIX No. 1 studio showing sponsor's gallery and the studio control room on upper level (solid lines) and 1st floor rooms



The nearly-completed WPIX studio is shown above with acoustical material and catwalk installed. Below right shows isolation material between outer wall and floating studio

built up from a wire lath and plaster frame with air space between it and the rock wool lining. The plastered wall on the room side is covered with perforated transite around the base to a height of 8 ft. Above the transite "dado" the walls are covered with a wood framework to which is attached sound absorption material — rock wool, in this instance. This material, in turn, is covered with plain muslin over which is stretched wire netting for support and protection.

The floor, like the walls, has a masonry base covered with sound isolation material. A network of floor channels supported by several layers of neoprene separated by steel plates was laid over the masonry floor to help support the inner room. Wire mesh was laid over the floor channels and concrete poured over that. The finished floor of the studio room will be bare concrete except when programming or sound requirements necessitate covering it.

The ceiling is constructed like the side walls except that is is entirely covered with perforated metal painted white to reflect light.

The entire room is floated — on the bottom by means of the channel platform which rests on neoprene; on the sides from brackets blanketed with neoprene; from the ceiling by approximately 80 steel springs each carrying a load of approximately 240 lbs.

The windows of the studio control room and sponsor's gallery are double plane, with one window set in the masonry wall and the other floating in the floating room. Windows are out-of-parallel to each other. The control room, gallery, recording room, news room are all treated according to the nature of their sound requirements and to prevent feedback.

All conduits for electrical wiring, air conditioning, etc., have flexible collars between the outer and inner rooms. The catwalk which extends around three sides of the studio is attached to the masonry ceiling of the outer room with its supporting poles encased in felt sleeves where they pass through the ceiling of the inner room.

While the studio room is rectangular, two of its walls are serrated for proper soundwave reflection and absorption. Otherwise the studio is quite plain and simple in design and interior finish, as described above and illustrated on these pages.

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WPIX

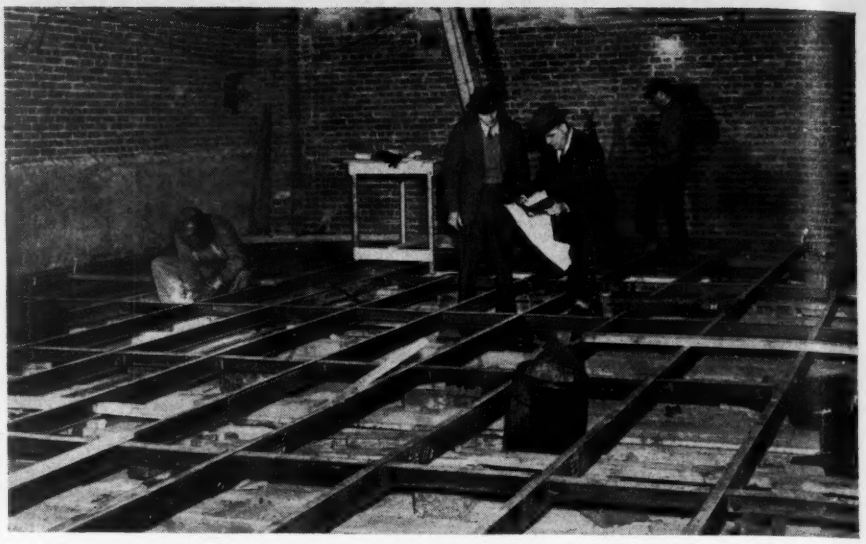
STUDIO DESIGN
(Continued)

The use of transite around the base of the room serves as much to protect the walls as to condition the sound in the room. Absorption of sound over its surface is in the low frequencies. The wire mesh and muslin covering the sound isolation material over the upper portion of the room leaves this area exposed for maximum high frequency absorption of sound. The perforated ceiling also permits high sound absorption. The result is a room with very little reverberation, except from the floor. The room is thus overtreated for musical sound and will need sets for proper reverberation if music originates in this studio.

Two dressing rooms back up an end wall of the studio while a news room and an accessory room are aligned along another wall. The studio control room is located directly over the dressing rooms and command a full view of the studio. The sponsor's gallery is above the news room with a clear view of the far side of the studio but not of the end where the control room is located. No facilities are provided for seating an audience. Recording and transcription rooms are on the same floor level as the sponsor's gallery.

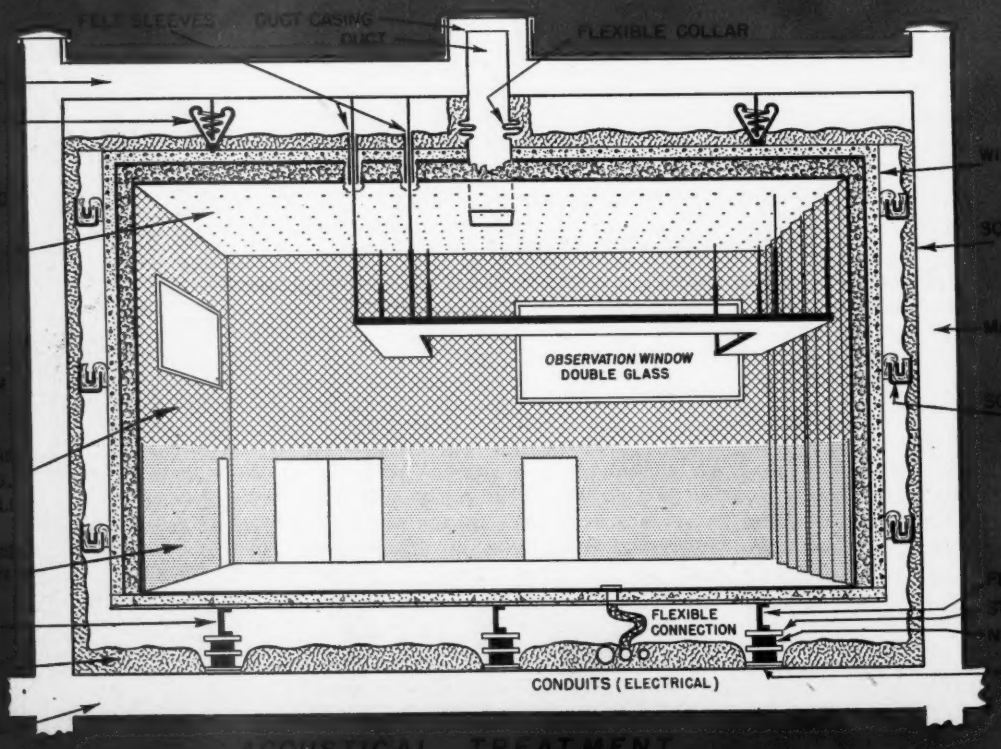
Equipment inside the studio will consist primarily of cameras, mikes, lights and sets. Temporarily, at least, the studio will operate with 3 RCA field camera chains equipped with image orthicon tubes. Two of these will be mounted on studio pedestals and the third will be mounted on a camera dolly with elevation facilities and manned by 2 assistants.

Main lighting equipment will include 15 fluorescent units having 6 lamps each so spaced about the studio that in between them it will be possible to mount 16 incandescent flood lamps. Overhead lighting and spots will be supplemented by 4 strip lights on the floor and several parabolas and spots mounted on floor stands.



I beams cushioned on neoprene pads under concrete floor help support floating studio

Details of construction, floating and sound proofing the No. 1 studio shown in this schematic. Material and installation by Johns-Manville



ACOUSTICAL TREATMENT
(ROOM WITHIN A ROOM)

WPIX TELEVISION STUDIO
DAILY NEWS BLDG. NEW YORK

ACOUSTIC MATERIALS and STRUCTURAL ELEMENTS
NOT DRAWN TO SCALE

POWER SUPPLY

WIRING • SWITCHING PLAN • LIGHTING

POWER requirements for the control rooms and for the transmitter installation at station WPIX are obtained from two sources. For the latter, facilities terminating on the 25th floor were extended, while the control rooms were fed from a new service. Electrical work was done by Belmont Electric Co., N. Y.

The new service is a 3-phase 4-wire system consisting of four 4 x ¼-in. bus feeders per phase. It has a peak load capacity of 4000 amp per phase and the neutral has a load capacity of 2000 amp. Each phase carries the current requirements for 2 studio lighting circuits as well as all power used by the audio and video control equipment and the motion picture projection equipment. Two 3½-in. conduits carry the service to the main distribution panel on the 11th floor.

The 10th floor is a maze of interconnecting metal cable trenches 12 in. wide and 6 in. deep. The cables connecting the equipment racks are laid openly in these trenches and thus are accessible for maintenance and connection changes. The cabinet racks in the master control room are placed directly over the cable trench and the remaining open portions of the trench are covered with metal floor plates that screw into place.

For incoming telephone circuits, three 3-in. and one 1¼-in. conduits have been installed between the electric shaft and the master control room. Two 2-in. conduits for control purposes between the transmitter and master control room have also been provided.

Conduits entering the studio are terminated in flexible connections so as not to interfere with the room's "floating" characteristics. When no program is in progress the studio is lighted by 4 small downlights. A switch in the announcer's booth extinguishes these lights as the program goes on the air. The studio lighting is then controlled by a lighting engineer who operates 4 "pre-set" lighting circuits. Each of these 4 circuits terminate in outlets near one of the 4 studio working areas and also in specially designed outlet plugs on the catwalk above. The "stage" outlets and outlet plugs receive power from a studio switchboard whose individual switches are in series with one of the lighting engineer's master controls. The special plugs on the catwalk facilitate tying any of the overhead lights into any of the 4 circuits. Likewise, the equipment on the studio floor can be connected into the desired circuit through the stage outlet terminating there.

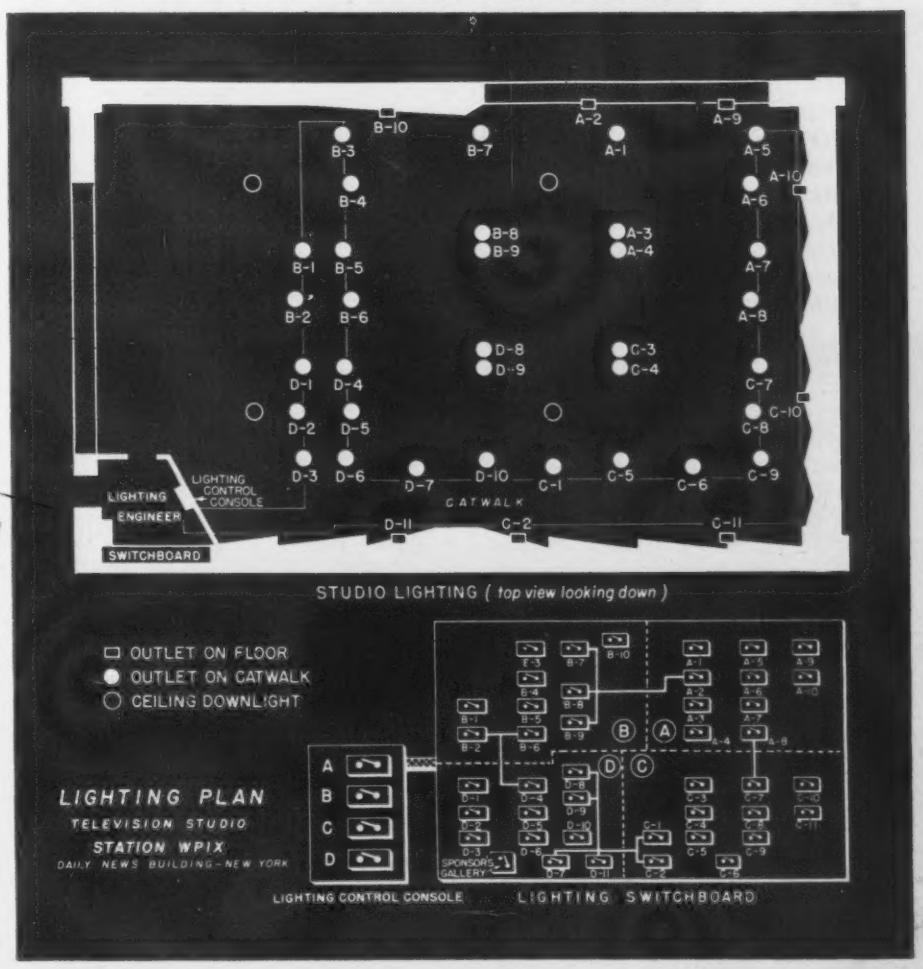
As shown in the illustration, it is also possible to switch some of the outlets of one circuit into another.

To provide power service for the transmitter and antenna installations, 2 sets of 350,000 circular mil and one 1/0 cable in 3-in. conduit were installed from the 25th floor switchboard room to switch and distribution boxes on the transmitter floor. For transmitter room lighting and auxiliary power, a 2-in. conduit containing three 2/0 and one 1/0 cable was also provided. Eight kilowatts were made available to the antenna and tower assembly for lighting and de-icing requirements.

Special 3-light fluorescent fixtures, providing 2 levels of illumination are installed in the sponsor's gallery, master control and transmitter rooms. In the latter 2 rooms lights are controlled by the engineer from the console.

Ten 12-in. standard, flush incandescent fixtures with glass lenses, equally spaced along the sides and back of the master control room, provide uniform light distribution over the control cabinet racks. The transmitter racks are similarly illuminated with adjustable recessed down lights.

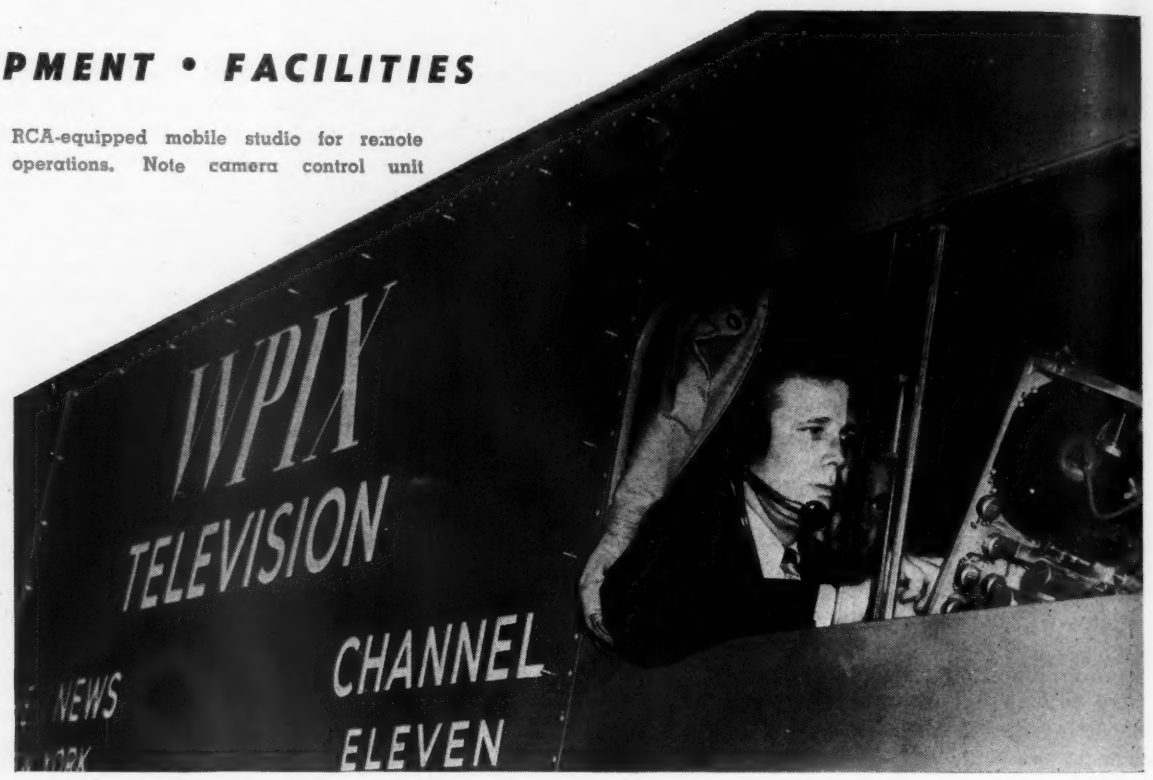
Lighting plan and control panel in WPIX studio show control possibilities; lights are preset



WPIX

REMOTE TECHNICS

EQUIPMENT • FACILITIES



RCA-equipped mobile studio for remote operations. Note camera control unit

REMOTE pickups by WPIX will greatly augment local studio presentations. These pickups are of several types so that any sort of event can be handled. Some will be for one-time affairs or infrequent schedules which involve complete setting up and tearing down of field equipment. Others of a "repeat" nature, will permit leaving some of the equipment, such as video cables, phone lines and power lines, as a permanent installation at the site.

Two mobile RCA units cover remote pickups with 2 RCA camera chains in each truck, together with an RCA microwave relay transmitter, 2 off-the-air receivers, an audio amplifier, 6 EE-8 telephone sets, directional microphones, assorted lenses, tools, test equipment, and spare parts. The quantity of some items, such as the number of microphones, number and type of lenses, and the number of camera chains are subject to requirements at the site, as recommended on a preliminary survey by an engineer and a program director. This prepared survey report form permits management to compute in advance about how much the pickup will cost, and the remote crews can get a preview of some of the technical problems to be handled.

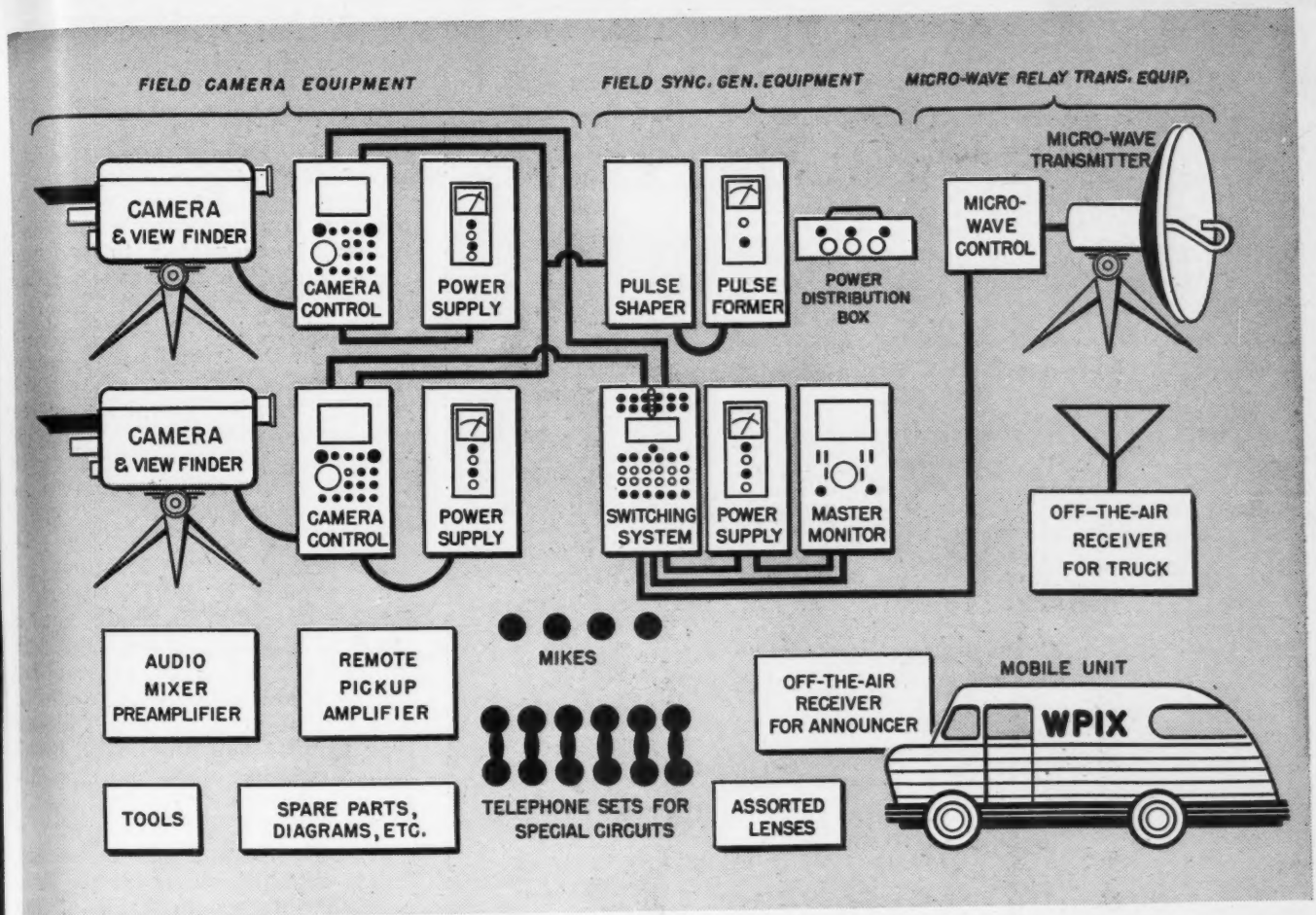
For a routine remote pickup a 6-man technical crew is a minimum requirement; the men are assigned as follows: 2 camera men, 2 video control men, 1 audio control man, and a relief man. A microwave transmitter operator is also required when the method of transmission uses this equipment. A program director in the mobile control room and one or more assistant directors at camera pickup points complete the remote crew.

The drawing shows that for a 2-camera chain using microwave relay, 14 units comprise the field video equipment. In operation, the camera receives horizontal and vertical driving signals from the field-synchronizing generator through an amplifier in the camera control unit. This unit also mixes the picture blanking signal with the camera video output signal. The camera control unit contains a 7-in. kinescope which is used as a picture monitor and a 3-in oscilloscope used as a waveform monitor. The output stage of the control unit is a line amplifier which feeds the field switching system.

The field switching unit is designed to accommodate 4 cameras and has provisions for 2 auxiliary video inputs. The program director selects the desired signal from the pictures appearing on the monitoring kinescopes in each of the camera control units. At the output of video amplifier in the switching unit, sync signals from the field sync generating equipment are added to furnish the output composite signal in its final form. The output of the switcher is connected to a master monitor and to the microwave relay transmitting control unit.

A 10-in. kinescope in the master monitor permits viewing the output picture and a 5-in. oscilloscope below it shows the output waveform.

The microwave transmitter is designed to operate between 6800 to 7050 mc and has an output of approximately 100 milliwatts. A 4-ft. antenna, having a gain of 5000, provides approximately 500 watts of



Block drawing of the mobile studio equipment, plus a minimum of 2 camera chains used in remote operations. Truck and equipment are RCA

radiated power in the direction of transmission. The transmitter is frequency-modulated with a frequency deviation of 10 mc at 100% modulation.

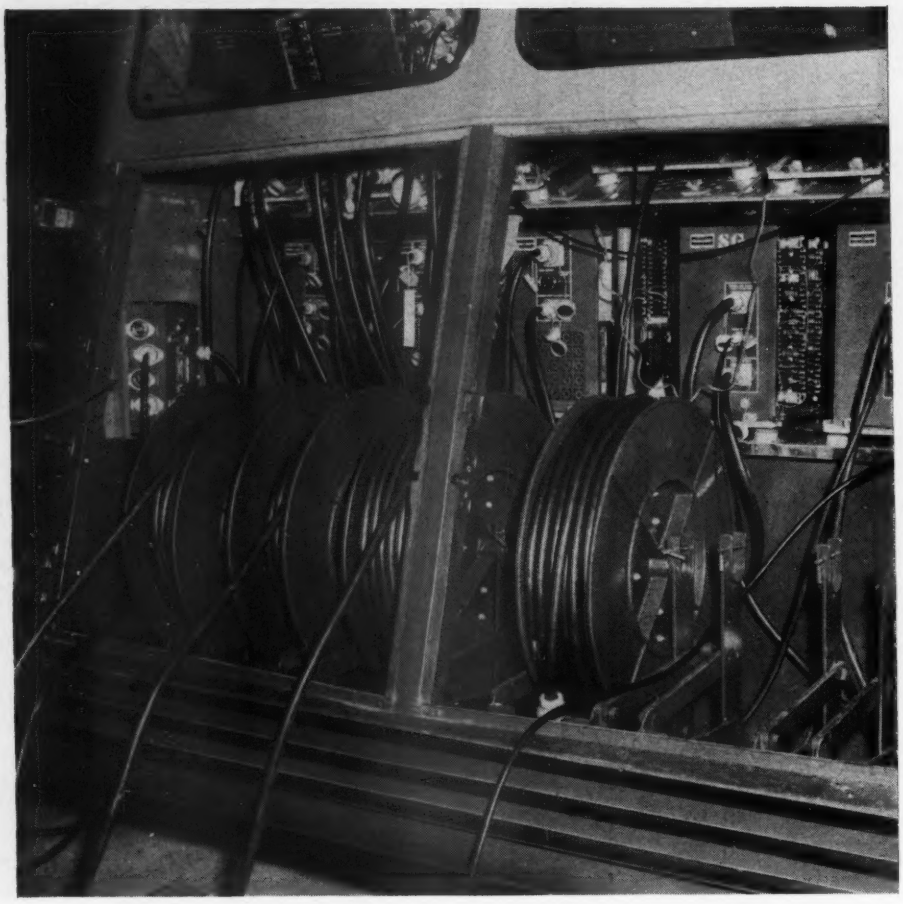
The power supplies used with the field camera equipment groups, and with the field switching equipment, operate from a 60-cycle single-phase power source with an input that can vary from 98-129 volts. 500 *ma dc* regulated output adjustable from 270 to 285 volts is produced. The power distribution box provides receptacles for power lines to all the units which comprise the field equipment. In the field sync generating equipment, the pulse forming unit generates the horizontal and vertical driving sync frequencies required, while the pulse shaping unit forms the pulses generated into the required waveshape and combines them into the final syncronizing voltage pattern.

The audio originating at remote pickups is transmitted back to the master control room over commercial telephone lines. Each WPIX mobile unit carries a mixer preamplifier and a remote pickup amplifier to provide the necessary signal levels from the mike inputs to the telephone lines.

An intercom switching section has also been provided in the field switching unit and program sound fed into this section is available to all personnel operating the pickup. In addition, the switching unit provides an engineering line between control and camera operators, and a program director's line. No extra phone lines have to be installed

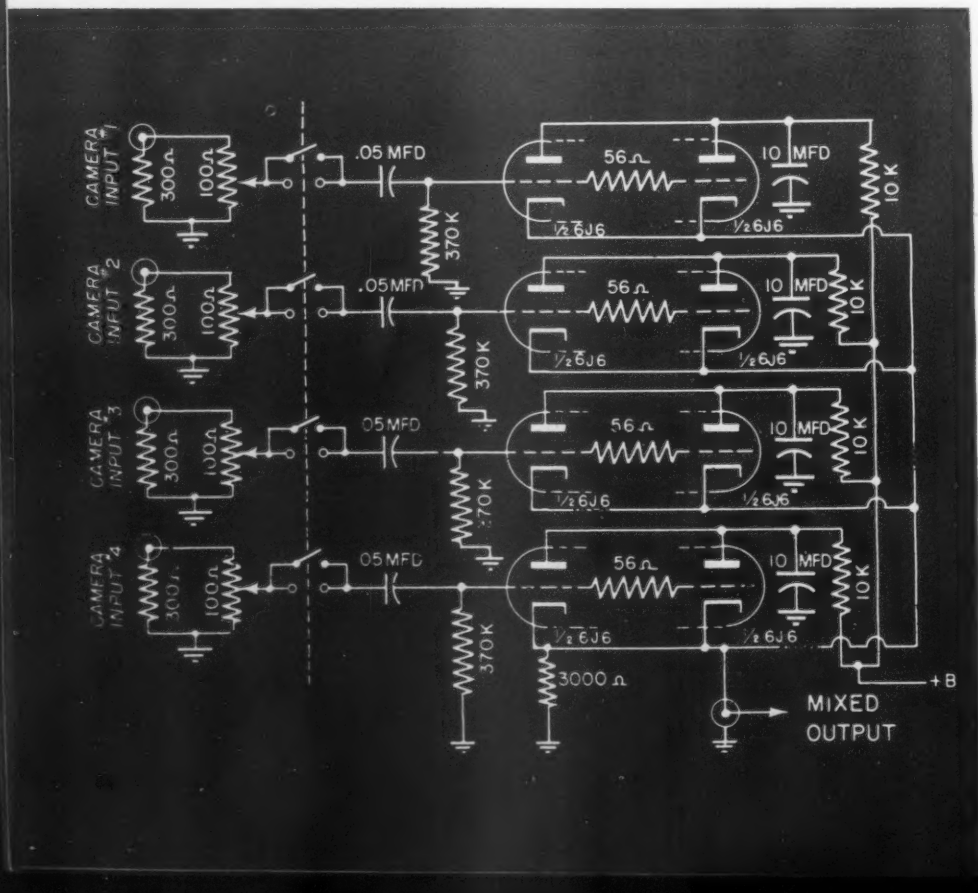
(Please turn to next page)

Remote mixer and preamplifier (1); master monitor (center); camera control unit (right)



Above: Rear view of mobile studio showing camera cables and reels capable of providing lines 200 to 1000 ft. Behind the reels are sync generators (left), power supply (right)

Below: WPIX engineers designed this video mixing unit for use with field switching systems to achieve lap dissolve and other special effects. Circuit is cathode follower type



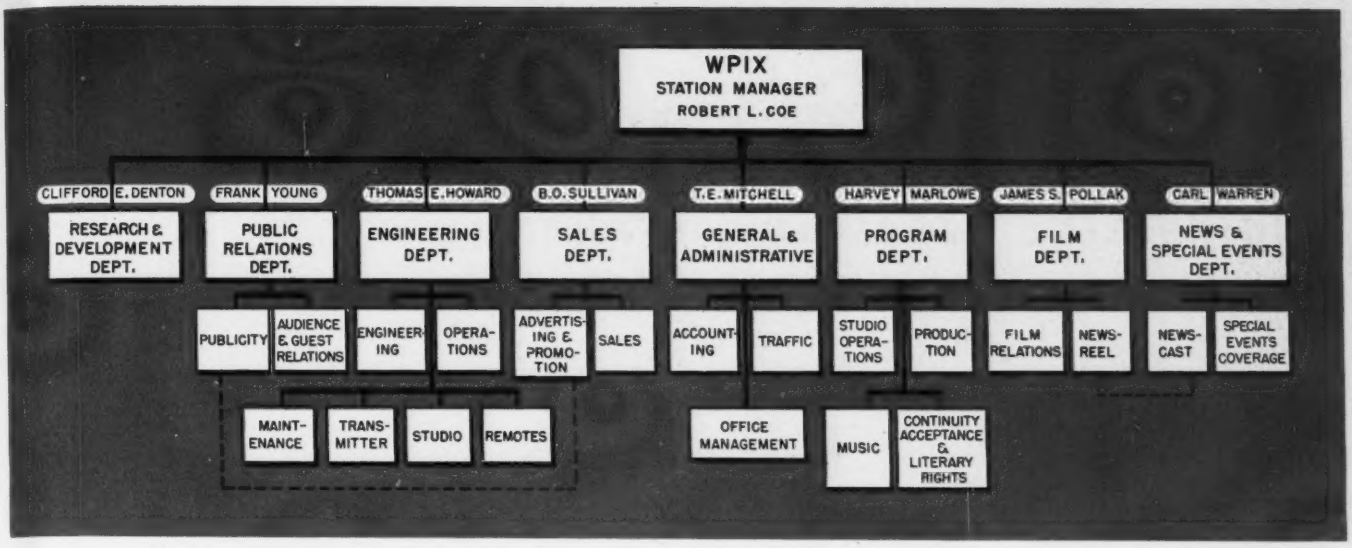
between camera and control points since the lines are already included in the camera cables. Each operator is equipped with a microphone and headset, and one earphone of the headset is connected to program sound while the other ties into the intercom switching unit.

One of the 2 off-the-air receivers carried in the truck is placed near the announcers position during the remote in order that he may see the same picture the television audience sees. The other receiver is used in the control room as an "On-the-Air" monitor.

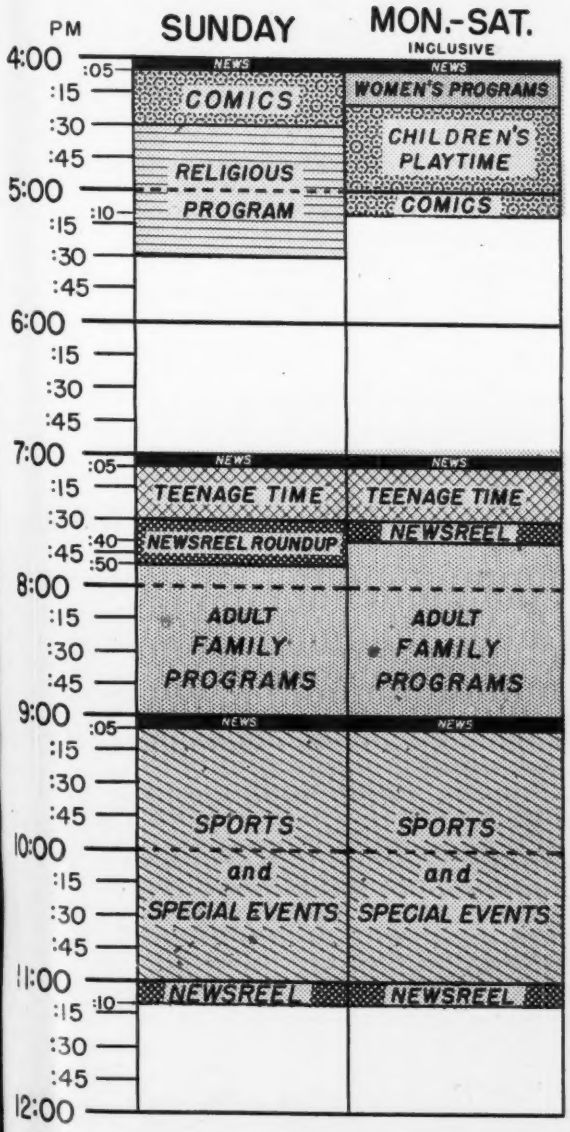
Means for some production programming at remote locations are being planned by WPIX engineers. For example they have designed a video mixing unit for use with field switching systems to achieve lap dissolves and other special effects. The circuit is a cathode follower type using 4 6J6 tubes. The push-button switches allow any of 4 different camera video output signals to be applied to the mixer, while a 4PST switch can tie all the camera inputs into the mixer at one time. A potentiometer in each of the mixer input circuits controls each camera's video input level. As shown in the diagram, the input impedance to the mixer will be approximately 75 ohms. The output taken across the common 3000-ohm cathode resistor, is terminated in a 75-ohm resistance within the camera control unit. A pilot light circuit is controlled with each of the push buttons thereby indicating which cameras are feeding the mixer.

By arrangements with the New York Telephone Co., video cable connections to the master control room will be available when WPIX microwave service is not suitable, or when cable facilities are more convenient. For nearby points in metropolitan areas 4-mc cables will be used. Microwave equipment may also be used in combination with cable lines for locations beyond the line-of-sight of the receiver.

Each complete 2-camera-chain remote equipment requires approximately 3½ kw of power at the remote site, and depending upon light conditions there, from 5 to 10 kw additional power may have to be supplied for lighting circuits. Special fibre weatherproof boxes have been constructed to house lenses, tubes and spare parts with sponge rubber being used as an insulating filler for fragile items.

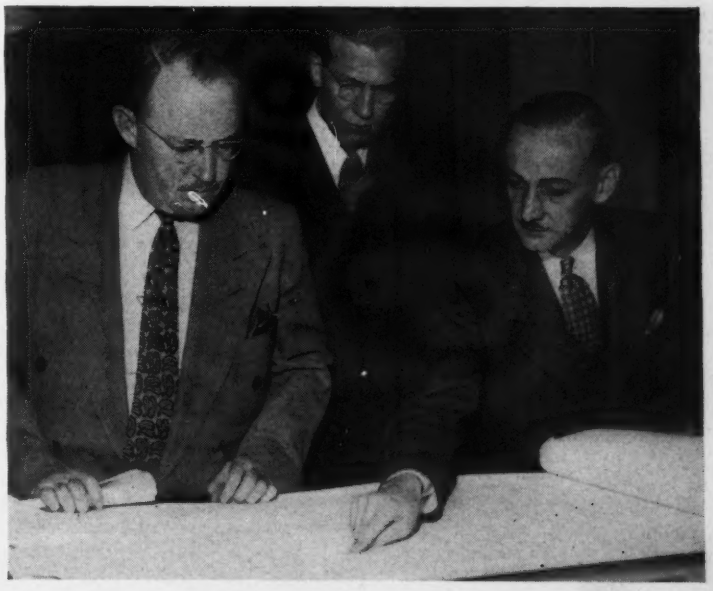


ORGANIZATION & PROGRAMS



WPIX is organized with 8 major operating units, as indicated in the chart above. Each is sparked by experienced specialists charged with the task of achieving an aggressive, coordinated operation. Their task is facilitated by a programming plan engineered by Program Director Harvey Marlowe to provide the maximum in public service, education, entertainment and information. A chart of the program policy is shown on the left. Below are the 3 men mainly responsible for this newest of independent, metropolitan television stations. Their courage, leadership and engineering knowledge assure a promising future for WPIX.

Inspecting WPIX plans are (l to r) F. M. Flynn, president, N. Y. Daily News; Robert L. Coe, WPIX manager; Thomas E. Howard, chief engineer



WPIX

SOUND

ENGINEERING • SPECIAL EQUIPMENT

AUDIO facilities at WPIX provide for a maximum of control flexibility and fidelity of transmission. Standard audio broadcasting components have been employed throughout the installation with extensive monitoring, patching and intercom facilities being provided at the control points.

RCA-type 44-BX, bidirectional, and RCA-type 77-D, polydirectional microphones are used where sound pickup is required. A wide variety of microphone stands including desk, floor, boom and boom perambulator types are available. Speakers for monitoring and for reproduction in places where high fidelity is desired are generally an RCA type LC-1A with other types on order. This duo-cone loudspeaker has a large outer cone to reproduce low frequencies and a small inner cone for high frequencies. The cones, coaxial direct radiating types, are individually driven and use a 4-mf capacitor in the cross-over network to limit the low frequency current flowing in the high frequency unit. A separate filter permits the speakers' response to be controlled for 5, 10, or 15 kc as desired.

An audio rack in the studio control room has patching facilities between the master control room, recording room, studio No. 1 and the new studio. Two RCA-type 70-D turntables provide audio outputs for dubbing, backgrounds, transcriptions, etc. An RCA 76-B4 control consolette provides switching, fading, and mixing requirements for 2 studios, an announce booth microphone, 2 transcription turntables and 6 remote lines.

Additional audio equipment installed on the studio floors includes: 4 RCA-type 73-B professional recorders used in conjunction with 2 Presto amplifiers for making acetate recordings, portable temporary audio equipment in the news studio consisting of a mixer preamplifier and a remote pickup amplifier, and extra loudspeakers in the halls, sponsor's gallery, etc., for reproducing program sound.

In the master control room the audio racks contain extensive provisions for patching audio circuits to and from the studios, film projection room and recording room. The main distribution console has patching facilities for 48 different circuits and through a 3-channel switching and mixing push-button interlock and preset control system, audio from any point on the studio floors can be tied in.

Currently 2 program lines from the master control room feed audio to the transmitter. These lines terminate in a monitoring rack on a jack strip in the transmitter room. The outgoing program is patched to a 75 microsecond pre-emphasis network, through a limiting amplifier to a level control attenuator network, and then to the transmitter input. A monitor speaker, fed through a 75 microsecond de-emphasis circuit and a monitoring amplifier permits the control operator to listen to outgoing program sound. A push-button system on the control console also permits inserting a VU meter or monitoring speaker into the different points along the system for level and quality checking purposes. For audio that might originate in the transmitter room a booster amplifier, a microphone and a transcription turntable are provided.

Communication by operating personnel between studios, master control room, transmitter room, main engineering office and from a remote point is provided by a special telephone system. Six push-buttons each connecting with one of the above mentioned locations permit either individual or party line conversations. A patching panel in the master control room is used to connect whichever remote circuit is desired.

SOURCES OF RADIO & TELEVISION INFORMATION — Technical . . . Merchandising . . . Industrial

Foremost technical journal of radio, television and tele-communications. . . . Greatest number of television and tele-communications editorial pages. . . . Authoritative treatment of current engineering trends, problems and developments. . . . Largest engineer-audience in design, manufacture, operation and maintenance of television and tele-communications (15,332 total effective April 1948).

Outstanding magazine of radio and television distribution. . . . 25-year leadership in publication of material on merchandising and servicing of radio, records and phonographs, electrical appliances, etc. . . . First in number of advertisers, in advertising pages, in dollar volume. . . . Largest paid circulation in radio-television trade. (28,000—Member, Audit Bureau of Circulations).

Only engineering publication devoted solely to electronic and electrical methods in industry. . . . Serving design and operating engineers and production executives . . . Receives 25,000 inquiries per year for new products and methods to improve industrial production. . . . Has five times as much industrial circulation as any other magazine in the radio-electronic field (30,000 total).

CALDWELL-CLEMENTS, INC. 480 Lexington Avenue NEW YORK 17, N. Y.

NEWS LETTER

$184 MILLION FOR MILITARY RADIO-ELECTRONIC PROCUREMENT APPROVED—A total of $184 million for Army-Navy-Air Force purchases and contract authorization of communications-radio-radar-electronic equipment, together with the allocation of over $32 million for continued research and development activities by private industrial and university laboratories, were contained in the 1949 fiscal year appropriation measure, passed by Congress before its adjournment for the three Military Services. Denoting the tremendous usefulness of electronic "weapons" in present-day military operations, the vast preponderance of the funds for the next fiscal year which began July 1, 1948, was for radar apparatus, both ground and airborne, and for the most modern radio communications equipment and systems. Presenting the justifications and plans of the 3 armed services, the main officers who testified before the Congressional appropriating committees were Major General S. B. Akin, Chief Signal Officer of the Army; Major General Francis L. Ankenbrandt, Air Communications Officer of the Air Force; Rear Admiral Earl E. Stone, Chief of Naval Communications; Major General L. C. Craigie, Director of Air Force research and development activities; Rear Admiral A. M. Pride, Chief of Navy Bureau of Aeronautics; and Vice Admiral E. W. Mills, Chief of the Navy Bureau of Ships.

FCC HEARING ON TV CHANNEL ASSIGNMENTS—More than 75 present and potential applicants for television stations were represented at the June 29 FCC oral arguments on TV channel allocation to local areas. The proceedings were staged by the Commission to ascertain the desires of the television broadcasting industry as to expansion of operations and service from the present more than 100 stations already authorized to establish video service in potentially 400 areas of the country. The FCC sessions also were designed to relocate any stations which had been previously given Channel 1, now turned back to the safety and emergency radio services like police, fire, forestry, etc.

BLUEPRINT OF MILITARY REQUIREMENTS AT RMA CONVENTION—A blueprint of the requirements of the Armed Services in procurement was given to the Radio Manufacturers Association as the highlight of the Association's annual convention in Chicago June 14-18 by the RMA Mobilization Liaison Committee, headed by Western Electric Vice President Fred R. Lack and composed of RCA-Victor Executive Frank M. Folsom and Hazeltine Electronics President W. A. MacDonald. Mr. Lack, who conferred with the Munitions Board of the National Military Establishment in Washington for the data on his address, led the discussion on "Military Procurement" at the June 17 RMA Membership Luncheon, most important gathering of the 24th annual RMA convention. Incidentally, TELE-TECH published in its June issue, the list of the military and civilian government agencies purchasing radio and electronic communication equipment for national defense requirements which was distributed a few days before the Munitions Board made public the Army-Air Force-Navy procurement agencies in the Board's important "Guide for Joint Industry-Military Procurement Planning."

RCA PIONEERS IN UHF TV; WESTINGHOUSE'S STRATOVISION—Determination of distribution of Television Channels for assignment which will come out of the June oral arguments is regarded as a stoppage to keep Television service progressing until the eventual move "upstairs" to the 475-890 megacycle band. RCA and NBC have already given impetus to the experimentation in the "upstairs" region by the plan of RCA to start operation of a video station on 504-510 mc about Sept. 1 in Washington which will duplicate the television programs of the already operating NBC station WNBW in the Nation's Capital. This project may cause the FCC to postpone its Sept. 20 hearings on ultra-high-frequency television so as to permit RCA and the other television and radio manufacturing companies which are experimenting in "upper band" video to accumulate and analyze the results of these operations. At the same time, Westinghouse has presented the FCC formally with its spectacular method of television relaying "Stratovision" (airborne radio relay through planes flying overhead in a specified area at 20,000 to 30,000 ft.) Westinghouse is planning to use the Stratovision sound and video signal relay system in the Pittsburgh area for TV Channel 8 both for commercial and experimental service and in the 500 mc region, experimentally.

NSRB PLANS UNIFICATION OF WIRE AND RADIO-ELECTRONICS—Because the art of communications is dependent to a large extent upon *electronics,* the National Security Resources Board, top-level planning agency of the Federal Government which reports only to the President on mobilization planning in event of war, is *not* going to split its Communication Division into two entities—wire and radio—as was done under the War Production Board in World War II. The NSRB plans to have in its division an Operating Industry Section of which one branch will include broadcasting, television and mobile radio, and a Manufacturing Section with an Electronics Branch, while there will be Manufacturing and Laboratories Advisory Committees.

ROLAND C. DAVIES
Washington Editor

National Press Building

FM Ring Antenna Design

Shunt-fed loop FM antenna. Junction box contains condenser elements for de-icing

Loop mounts on AM tower's rf transmission line with minor change in radiation pattern

*By HARVEY KEES, Engineering Services, Inc., Evansville, Ind.**

THIS Collins 37M ring antenna for FM consists of a shunt-fed loop supported by its feeding transmission line which is usually mounted on the side of a suitable tower or pole. The loop has a circumference of approximately ⅜ wave, and is tuned to half-wave resonance by adjustable end-loading capacitors (the circular plates visible in the photograph).

The simple shunt-feed system and loop mounting allow a high-gain antenna array to be built up of any desired number of units. These can be mounted on a single length of transmission line and spaced any number of half-wave lengths apart, although maximum gain with greatest economy is usually obtained with full-wave spacing between adjacent loops. Theoretically, the power gain of any multi-element antenna array (compared to a half-wave dipole) employing full-wave spacing between adjacent elements is approximately equal to the number of elements involved. Thus, the gain of a 5-loop system is 5, and the gain on a 10-loop array is 10. However, it is generally considered impractical to use an FM antenna with a power gain of more than approximately 8 because of the narrow vertical beam width of such high-gain systems.

The light weight and simplicity of the FM shunt-fed loop have resulted in its acceptance for mounting on existing AM towers. Careful measurements of the horizontal radiation pattern of the loop mounted on the side of a Wincharger tower, and on a Lingo pole of 10 in. diameter show that its directional characteristics are virtually unaffected by these mountings. The pattern depends somewhat on frequency, but it is within 1 db of being circular under all conditions.

The bandwidth of the antenna also changes to a minor degree with frequency. However, it is more than ½ mc to the 2/1 VSWR points under all operating conditions. This figure is about the optimum compromise between physical size and mechanical stability.

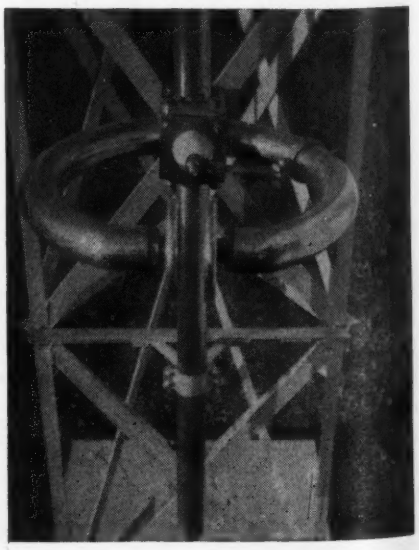
A loop array can be tuned on the ground, or in the air, by a rather simple and straightforward process. This consists of experimentally setting the capacitor plate spacing and feeding tap position on one loop to obtain a non-reactive impedance which is equal to the product of the transmission line impedance and the number of loops involved. Then, similar settings are made on all the loops of an array, which are paralleled for normal operation. The complete tuning operation can be made with a simple slotted line or other high-frequency impedance-measuring device.

A design in which the loop is mounted directly on standard-type rf transmission line permits its use on the side of many standard AM towers and poles with negligible changes in its radiation pattern.

This characteristic, added to the fact that installation problems are much less complex than with the around-the-pole type antenna have led to its preference. Manufacturing and tuning of the transmission-line-mounted antenna are simplified because of the similarity of all loops in an array. It is also relatively easy to make changes in or additions to this type Collins 37M ring antenna.

Provisions have been made for de-icing the loops by installation of heater elements in the condenser plates. A convenient means of connection to these elements is provided in the form of a junction box on the back side of the loop, as can be seen in the photographs.

FM antenna shown mounted on an AM tower and attached to standard coaxial line



*Ring antenna, developed by Engineering Services, Inc., is now being made by Collins Radio as model 37M.

Two-Color Radar

Provides constant measurements from plane to fixed ground beacons; system developed at research labs in Federal's 300-ft. tower

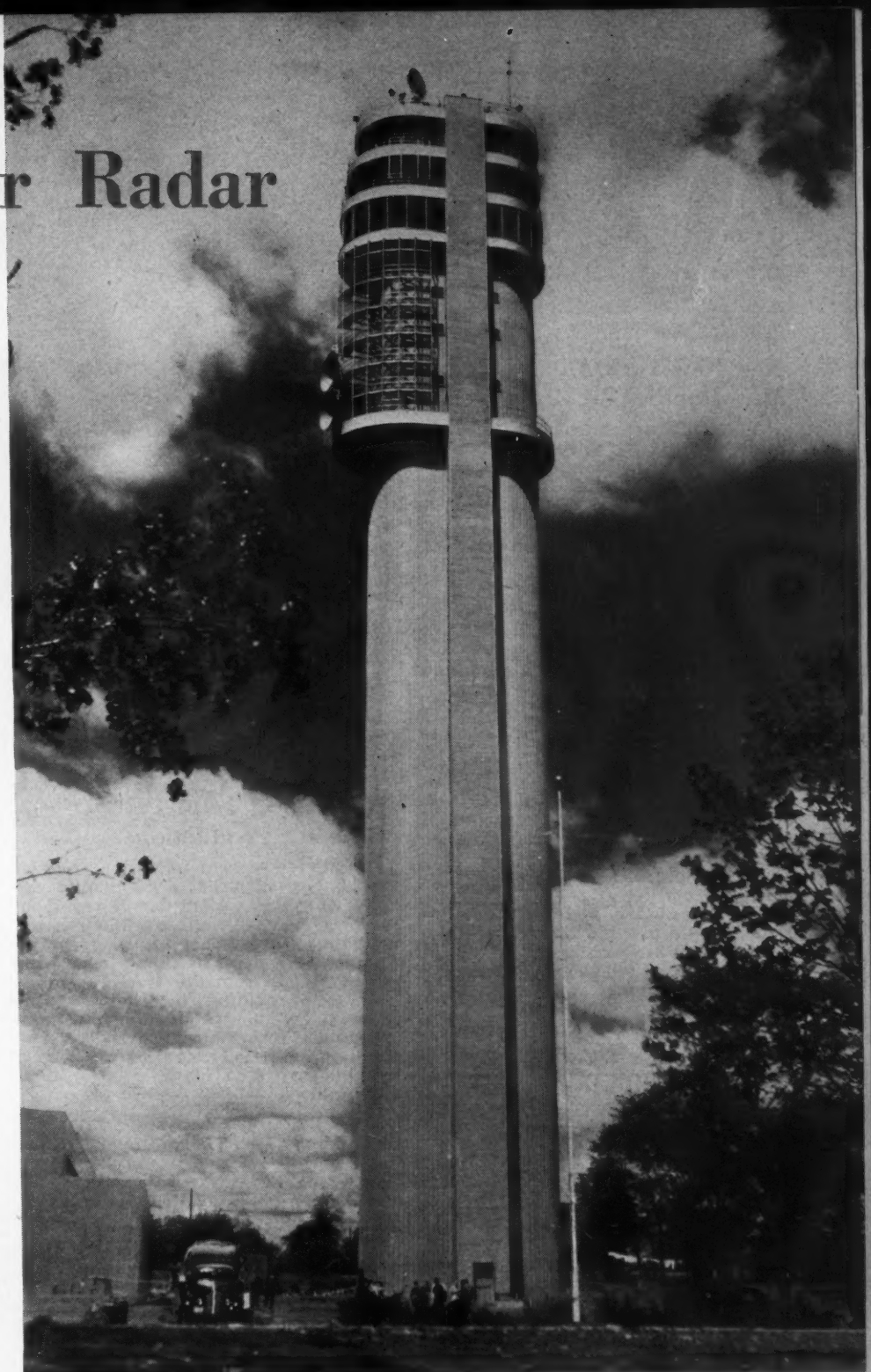
ONE more step in the development of the centralized research program of the International Telephone and Telegraph Corp., was made recently with the completion of a 300-ft., aluminum-sheathed tower built to enable electronic engineers to work in the field of microwaves under the most advantageous conditions. This research unit of I.T.&T. is handled by the Federal Telecommunication Labs. at Nutley, New Jersey.

Six levels of research activity are handled in this microwave tower in compact laboratory rooms 20-odd stories above ground.

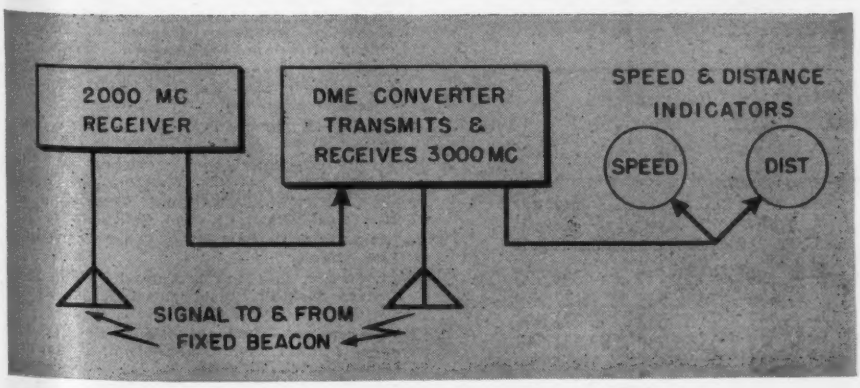
At the dedication of the facilities at the tower Federal's new DME (Distance Measuring Equipment) was demonstrated—a radar device which provides constant and accurate measurement of distances from plane to fixed ground beacons. Tele-Tech's representative studied this and other aerial navigation aids during a flight aboard a "flying laboratory" (a converted DC-3).

In the DME system, distance is measured by an airborne challenger operating in conjunction with a ground beacon, both of which have a pulsed transmitter and a receiver. The transmitter in the aircraft starts the measuring process when it sends out a challenging pulse at about 3000 mc. This is received at the ground beacon and causes its transmitter to respond with a similar pulse. When the response pulse

(*Continued on page 96*)



Aluminum-sheathed 300-ft. tower houses distance measuring equipment and other Federal microwave devices in compact laboratory rooms more than 20 stories above the ground



Block diagram showing airborne challenger which transmits 3000-mc signal to tower

TELE-TECH's NEWSCAST

New New York-Albany Cable May Handle TV Programs

A long distance coaxial telephone cable, recently put into service between New York and Albany by the American Telephone and Telegraph Co. contains 8 coaxial tubes, a pair of which is capable of handling about 600 simultaneous telephone conversations or 2 television programs. About as thick as a rolling pin, the new cable also contains several wire conductors used for the control of the cable's auxiliary equipment and additional long distance service along the route.

RCA Experimental TV

Plans for installation of a television experimental station in Wardman Park Hotel, Washington, D. C., are moving ahead according to Dr. C. B. Jolliffe, executive vice-president in charge of RCA Laboratories, since recent application to the FCC for the license to proceed with the new experiments.

"Results of the tests," Dr. Jolliffe said, "should provide further information on the problem involved in the development of television on frequenties above 500 mc, and if successful will be a major contribution to the expansion of this service to the pubilc."

WINX Satellite Boosts BC

Broadcast satellite station experiment by WINX, Washington, D. C., in which signals for the station's transmitter are picked up by 12 satellite transmitters and retransmitted to boost the station's signal coverage, is arousing some interesting observations. Legal opinion is that a "satellite" set-up would be viewed as **one** station by the FCC, regardless of how many satellites the station spots around its transmitter.

The engineering department of the FCC reports that the WINX special license was experimental only and that no more similar licenses will be granted until there is a general hearing—in about a year! Tele-Tech is planning a technical report on the experiment for an early issue.

Members of the Committee for the Chicago IRE Conference held at the Illinois Institute of Technology recently are: Rear row (left to right): Jean Brand, Arrangements; E. O. Ross, Arrangements Vice Ch'man; Leo G. Killian, Publicity Ch'man; Prof. G. F. Levey, Conference Committee; W. P. Keller, Publicity; R. M. Kreuger, Membership Ch'man; K. W. Jarvis, Program; Alois W. Graf, Scanfax; J. A. Meyers, Jr., Arrangements Ch'man. Front rof (left to right): W. R. Brock, Arrangements; Cal Sloan; Arrangements; Don Haines, Sec.-Treas.; Harold-Renne, Scanfax Ch'man; E. H. Schulz, Conference Ch'n; Arch Brolley, Program; O. D. Westberg, Exhibits

DuMont to Triple Receiver Production

DuMont's present television receiver production of 3,000 a month is expected to be tripled by the end of 1948 as a result of the company's acquisition of a part of the former Wright Aeronautical plant, East Paterson, N. J. from the WAA. In addition to providing facilities for increased receiver production and storage space for raw materials, the new building will also house DuMont's new cathode-ray tube plant.

45 Western Electric FM Transmitters Delivered

Over 23 of the 45 10-kw FM transmitters that have been delivered by Western Electric are already in service. These transmitters have been delivered either as complete new equipment or as 10-kw amplifiers to be used with the station's Western Electric 1-kw driver.

Orders for 7 Western Electric 25B Speech Input Consoles have been placed by WHAS, Louisville, Ky., which are to be consolidated into a system designed specifically for WHAS's operating requirements.

Osbahr Joins Tele-Tech

Bernard F. Osbahr has joined TELE-TECH as assistant editor. He has been active in radio and communications for the past 12 years, having served as an RCA field engineer specializing on television receivers. He was also an instructor for the New York School of Radio and, during service in the Army, was a radio instructor with added responsibility for FM and AM communication equipment maintenance.

New Officers for Remco

Due to the recent death of Irving Rose, former president of Remco Electronic, Inc., N. Y. C., the company has appointed the following officers: Charles F. Stromeyer, vice-president of the Hytron Radio and Electronics Corp. of Salem, Mass., as the new president of Remco; William W. Roberts, chief engineer of Remco, will continue as vice-president.

TELEVISION-RADIO PRODUCTION BOX SCORE

(RMA Members)

Receiver Production	Jan.	Feb.	March	April	May	Postwar Totals
Television	30,001	35,889	52,137	46,339	50,117	339,590
Consoles	13,261	10,295	15,304	12,536	12,535	127,984
Table M.	16,740	25,594	37,833	33,803	37,642	272,606
AM & FM	1,339,256	1,379,605	1,633,435	1,182,473	1,096,780	37,631,549
AM-FM	136,015	140,629	161,185	90,635	76,435	1,910,899

CONVENTIONS AND MEETINGS

July 29-31—Second Symposium on Applied Mathematics, American Mathematical Society with the co-sponsorship of the American Institute of Physics, Cambridge, Mass.

August 20-29—First Annual All Electronic Exposition, Southern California Radio and Electrical Appliance Exposition, Pan Pacific Auditorium, Los Angeles.

August 24-27.—American Institute of Electrical Engineers, (Pacific General Meeting), Spokane, Washington.

Sept. 6-7—Mathematical Association of America, Madison, Wisconsin.

Sept. 13-17—American Association for Advancement of Science, Washington, D. C.

Sept. 18-26—First National Television and Electrical Show, Chicago Coliseum.

Sept. 30-Oct. 3—IRE West Coast Convention, Los Angeles.

Sept. 30-Oct. 2.—Fourth Annual Pacific Electronics Exhibit, West Coast Mfgs. Assoc., Biltmore Hotel, Los Angeles.

November 4-6—National Electronics Conference, Annual Technical Forum, Edgewater Beach Hotel, Chicago.

acclaimed... with Praise! with Sales!

TODAY'S MOST WANTED TELEVISION RECEIVER

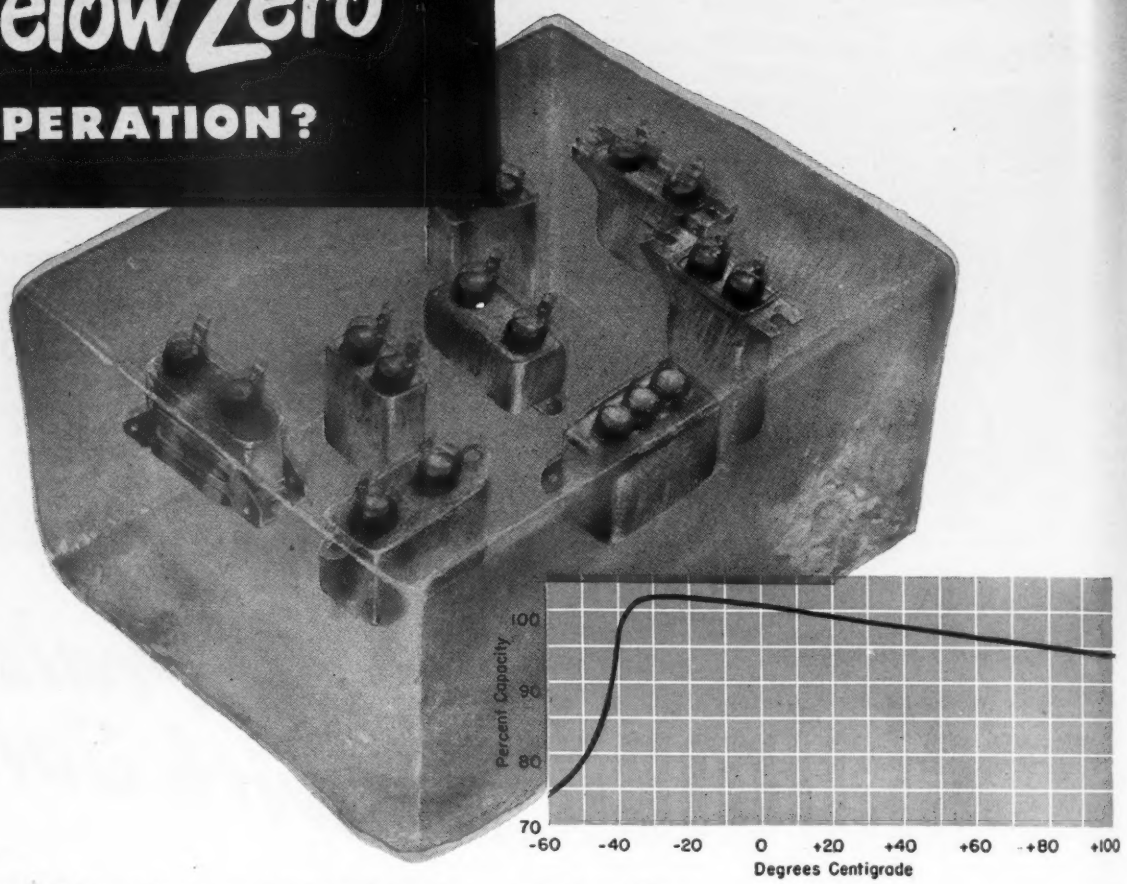
In every city where television receivers are sold, the Motorola Model VT71 has been enthusiastically received as the outstanding television value on the market. It is praised by dealers because of its ready saleability — acclaimed by customers for its clear, bright pictures and glorious sound — acclaimed by all because it is the first television receiver priced and produced to bring the miracle of television to all the people.

Now, and from now on, your leading name in television is Motorola. Feature it with pride — sell it with confidence.

Motorola Inc.
4545 Augusta Boulevard
Chicago 51, Illinois

Motorola GOLDEN VIEW TELEVISION

D-C CAPACITORS FOR Below Zero OPERATION?



Take advantage of the small size and light weight of Pyranol® d-c capacitors for those applications in freezing temperatures and below. No need to penalize your designs with oversize capacitors resulting from the use of other dielectrics.

Pyranol capacitors, as improved in recent years, are not only suitable for operation at temperatures up to 85C, but can also be operated at temperatures down to —40C. Throughout this wide temperature range, the capacitance remains within plus or minus 5% of its 25C value.

Here are some of the advantages you'll secure by using Pyranol capacitors—styles 50 through 69 like those pictured above—built to commercial standards:

- Size is smaller.
- Most commercial standard ratings can be shipped from stock.
- Pyranol is non-flammable.
- Like other G-E small capacitors, Pyranol commercial-standard capacitors are hermetically sealed in drawn cases—hot tinned for resistance to corrosion. They use the new silicone-gasketed bushing as insurance against leaks. They are all *individually* tested.

For specifications and details, ask for GEA-2621. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

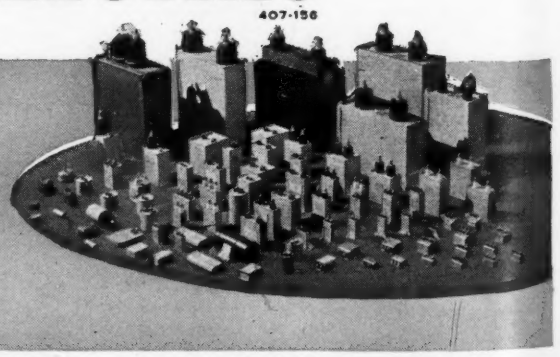
GENERAL ELECTRIC

407-156

Specialty Capacitors FOR

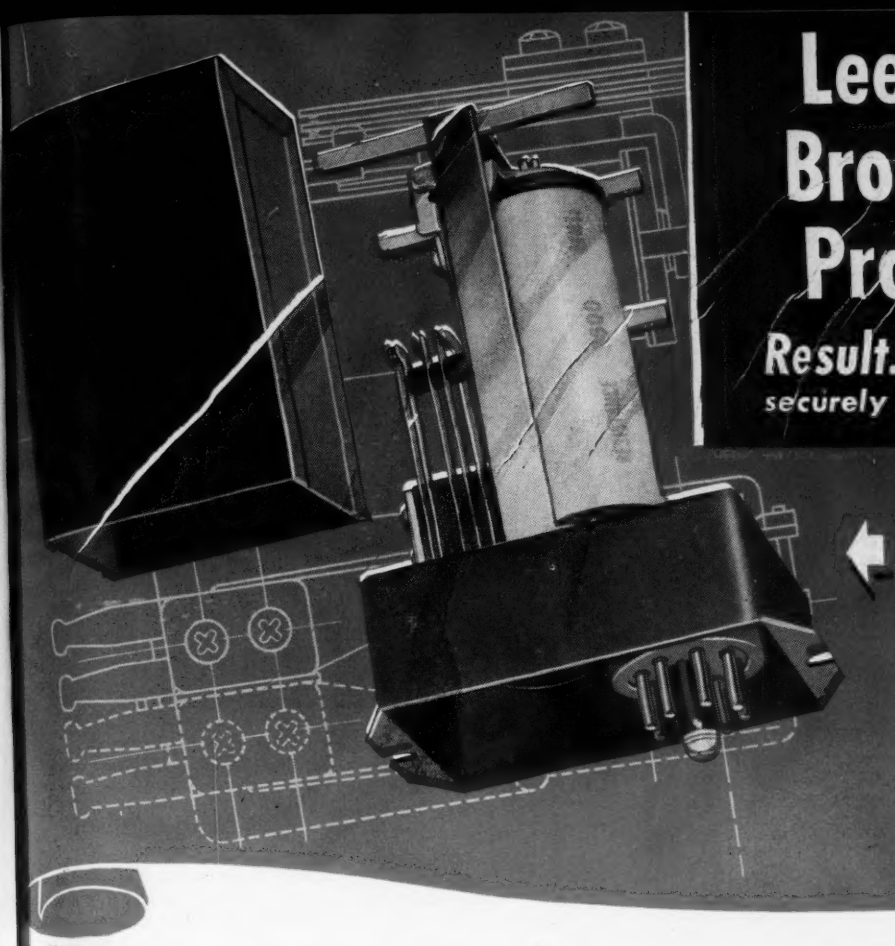
- Motors
- Luminous-tube transformers
- Fluorescent lamp ballasts
- Industrial control
- Radio filters
- Radar
- Electronic equipment
- Communication systems
- Capacitor discharge welding
- Flash photography
- Stroboscopic equipment
- Television
- Dust precipitators
- Radio interference suppression
- Impulse generators

AND MANY OTHER APPLICATIONS



Leeds & Northrup Brought This Relay Problem to CLARE

Result... *A dust-tight relay base and cover, securely fastened, with cover easily removed!*



Clare Type "C" d-c Relay, dust-tight mounted on base provided with Neoprene gasket, with easily removable dust-tight steel cover, as developed for Leeds & Northrup.

Electrical controls produced by Leeds & Northrup, Philadelphia, are frequently called upon to operate at plant locations where dust conditions may affect the operations of unprotected components.

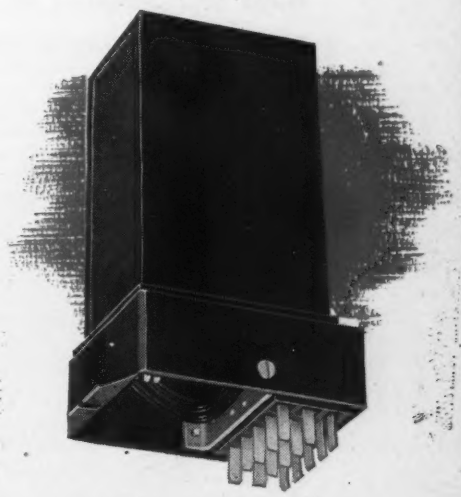
Their engineers called on CLARE for a plug-in relay that could be firmly secured to a chassis so that the plug could not be jarred or pulled out accidentally. A thoroughly dust-tight cover was required, yet it had to be easily removable for inspection.

CLARE engineers, in cooperation with Leeds & Northrup engineers, provided a cover base which contained a Neoprene gasket, closely fitted to the relay terminals for effective dust protection. They devised a steel cover which, firmly secured to the base by a thumb nut, could be readily removed. A standard radio type plug and notched flanges to permit rigid chassis installation completed the equipment.

Flexibility of this installation was soon demonstrated when a similar dust-protection problem came to CLARE engineers from United Air Lines. In this case a 15-point plug of different design was provided and a single flange for securing to the chassis.

If your problem has to do with relays, save time and expensive experiments by bringing it to CLARE. Take advantage of our long experience with every type of industrial relay problem. Call on CLARE sales engineers, located in principal cities, or write now to C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada, contact Canadian Line Materials Ltd., Toronto 13. Cable Address: CLARELAY.

View of base assembly of dust-tight relay mounting showing terminals brought through Neoprene gasket. Note radio-type plug and flanges for securing to chassis.



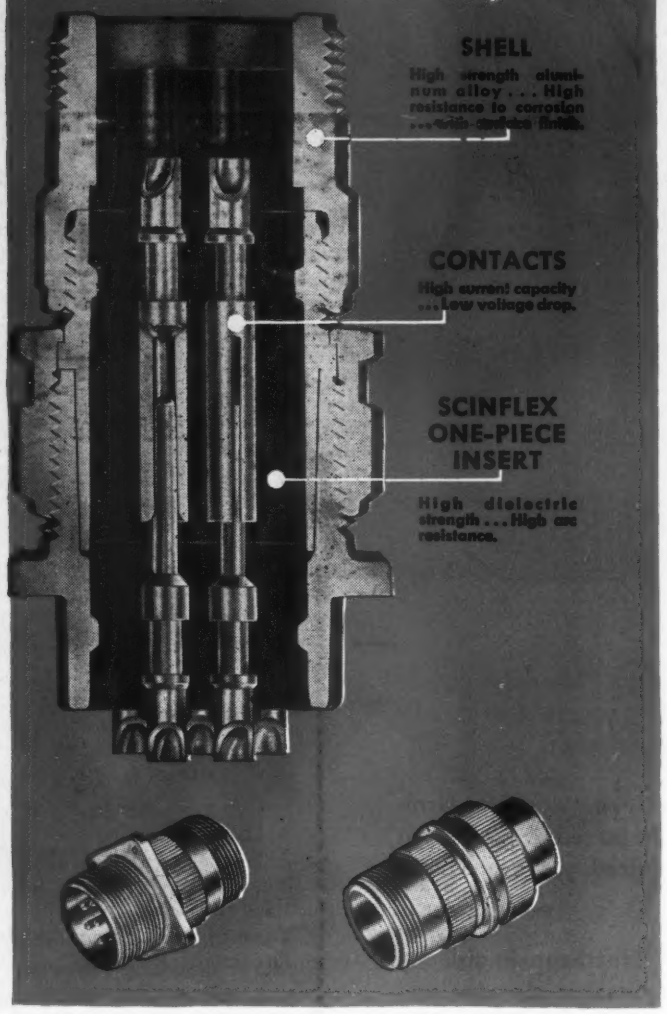
Same installation as changed for use of United Air Lines. Note installation of the 15-point plug and single flange for mounting to chassis.

CLARE RELAYS

First in the Industrial Field

BENDIX-SCINTILLA

the finest ELECTRICAL CONNECTORS money can build or buy!


SHELL
High strength aluminum alloy . . . High resistance to corrosion . . . Olive-drab finish.
CONTACTS
High current capacity . . . Low voltage drop.
SCINFLEX ONE-PIECE INSERT
High dielectric strength . . . High arc resistance.

AND THE SECRET IS SCINFLEX!

Bendix-Scintilla* Electrical Connectors are precision-built to render peak efficiency day-in and day-out even under difficult operating conditions. The use of "Scinflex" dielectric material, a new Bendix-Scintilla development of outstanding stability, makes them vibration-proof, moisture-proof, pressure-tight, and increases flashover and creepage distances. In temperature extremes, from —67° F. to +300° F., performance is remarkable. Dielectric strength is never less than 300 volts per mil.

The contacts, made of the finest materials, carry maximum currents with the lowest voltage drop known to the industry. Bendix-Scintilla Connectors have fewer parts than any other connector on the market—an exclusive feature that means lower maintenance cost and better performance.

*REG. U.S. PAT. OFF.

Write our Sales Department for detailed information.

• Moisture-proof, Pressure-tight • Radio Quiet • Single-piece Inserts • Vibration-proof • Light Weight • High Arc Resistance • Easy Assembly and Disassembly • Less parts than any other Connector

Available in all Standard A.N. Contact Configurations

BENDIX SCINTILLA — SCINTILLA MAGNETO DIVISION OF SIDNEY, N. Y. — AVIATION CORPORATION

NEWS . . .

Small stations can function as network outlets or originate their own programs with the new RCA 500-watt television transmitter. Designated the TT-500A and using a 3-section super turnstile antenna having a gain of about 4, an effective 2 kw of radiated output is achieved. High level modulation is employed in the power stages and the video portion automatically maintains proper black level. The sound section is a modified RCA 250-watt FM transmitter. When installed as one unit, the transmitter is 58 in. wide. A console containing both a switching unit and a monitoring unit provides fingertip control for operating and monitoring the transmitter.

FCC Issues First Certificate of Type Approval

The Radalite Corp., New York City, has received the first certificate of type approval issued by the FCC under the provisions of part 18 of its Rules Governing Miscellaneous Equipment. The certificate was granted for an interchangeable neon sign which is activated by radio frequency energy.

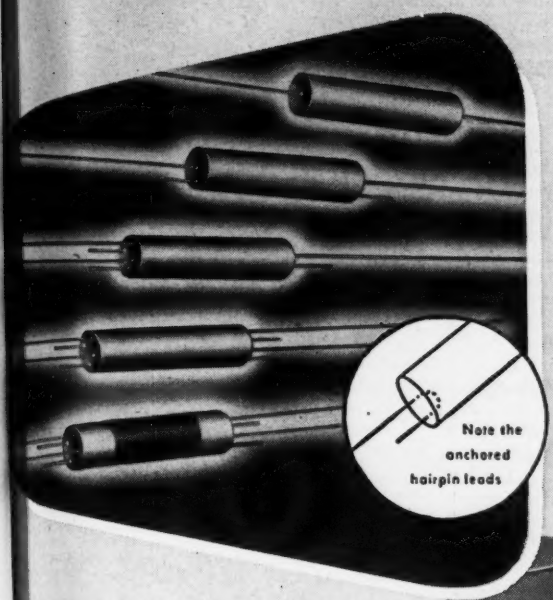
Relay Mfg. Appointments

Ralph T. Brengle, president of the National Association of Relay Manufacturers, has appointed the following members to the Committee on Standards and Nomenclature for 1948: J. E. Mossman, Phillips Control Corp., Chairman; E. H. Gillette, Allied Control Corp., Inc.; Fred W. Falck, Jr., Advance Electric & Relay Co.; R. M. Brumfield, Potter and Brumfield Mfg. Co., Inc.; F. F. Rowell, Sr., Guardian Electric Mfg. Co.

GE's TV Research

A new television division has been established in the General Electric Research Laboratory. Clifford G. Fick, until recently division engineer of the receiver division, has been chosen its head. Institution of the new division was announced by Dr. C. G. Suits, GE vice-president and director of research who predicts that the laboratory will make fundamental scientific contributions to television.

UCTS for TELEVISION



MOLDED COIL FORMS

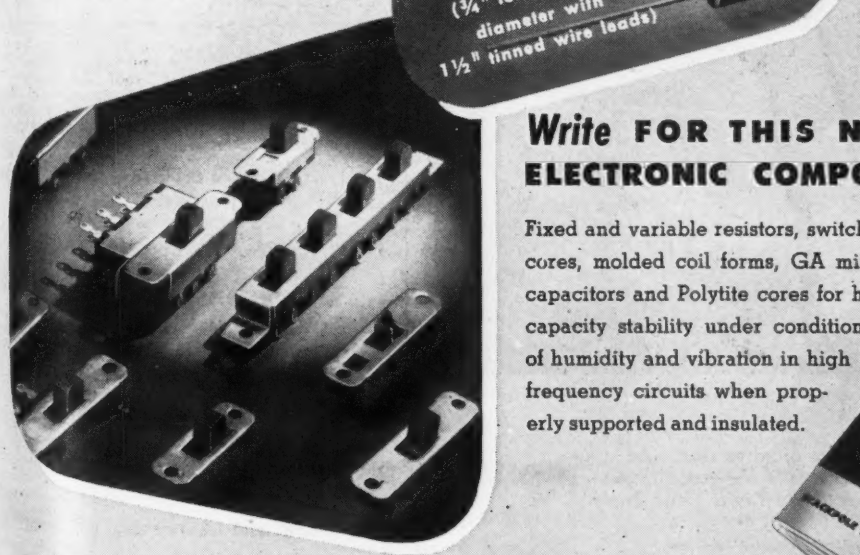
for choke and peaking coils

The advantages of Stackpole Molded Coil Forms as inexpensive mechanical supports for windings include: reduced space factor; easier assembly; point-to-point wiring with one-third fewer soldered connections; extreme flexibility of application *and absolute minimum cost.* Types include units with coaxial leads, single hairpin leads, single hairpin lead at one end with double hairpin lead at other end, and double hairpin leads at each end. Iron core sections can be incorporated in most types.

Note: These values apply to type DR coil forms only	Dielectric Constant	"Q"
600 Kilocycles	4.7	28
1000 Kilocycles	4.7	36
2.3 Megacycles	4.7	45
20 Megacycles	4.7	118
48 Megacycles	4.5	90

INEXPENSIVE SNAP SLIDE OR ROTARY ACTION SWITCHES

These popular Stackpole switches add greatly to the sales appeal and convenience of almost any electrical product. Standard, low cost types are available for practically any switching arrangement or type of operation.

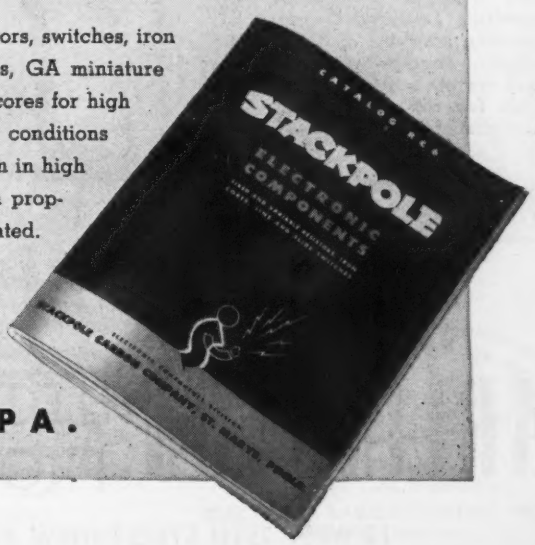


FIXED RESISTORS

The result of more than 15 years specialized manufacturing experience, Stackpole Resistors meet modern television specifications —whether from a moisture-protection, insulation or overload standpoint, or satisfactory high frequency characteristic. Standard ranges are from 10 ohms to 20 megohms in the customary ± tolerances of 5%, 10% or 20%.

Write FOR THIS NEW STACKPOLE ELECTRONIC COMPONENTS CATALOG

Fixed and variable resistors, switches, iron cores, molded coil forms, GA miniature capacitors and Polytite cores for high capacity stability under conditions of humidity and vibration in high frequency circuits when properly supported and insulated.



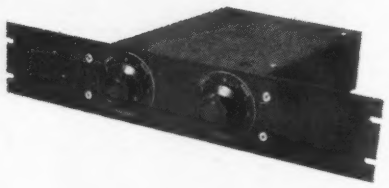
ARBON CO. • ST. MARYS, PA.

We did it for WPIX

. . . WE CAN DO IT FOR *you!*

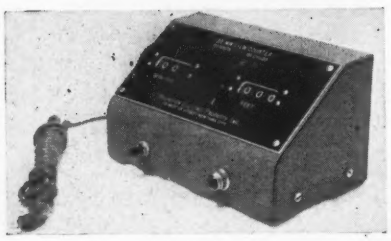
PORTABLE FILM RECORDING AMPLIFIER RA-2

Compact, portable, and complete with its own power supply, this equipment is ideal for single system film recording on location. It incorporates on a single control panel all the necessary facilities for two-channel mixing, and includes noise reduction, monitoring, dialogue equalization and exciter lamp control. The basic unit can be engineered to meet your specific requirements.



AUDIO COMPENSATOR EA-2

Consisting of a 2 stage "RC" amplifier, this accurately designed equalizer has either zero insertion loss or 25 Db gain. The high and low frequency switches, each having three lower, three raise and one flat position, give 8 Db of equalization and 16 Db of attenuation at both ends. A must for film, disc, and magnetic recording and playback.

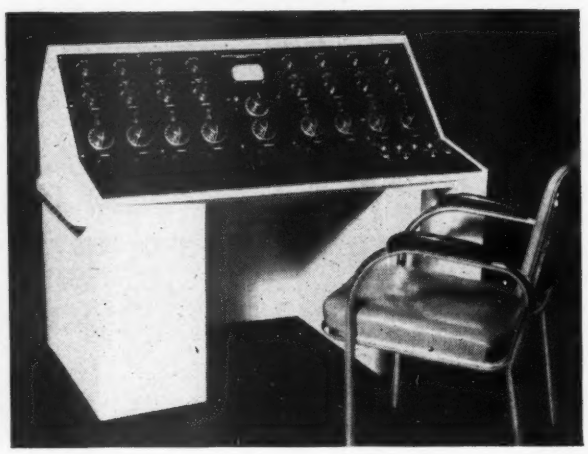


FILM COUNTER FC-3

This counter is extremely valuable for narrating, dubbing, re-recording and previewing. It indicates feet of film and elapsed time by means of a synchronous motor drive. The counter comes in 16 mm and 35 mm models. A special model using large numerals that are illuminated with black light for use in the dark, is also available.

MIXING CONSOLE MC-2

These units are custom-built to individual studio requirements. The illustrated Model MC-2 has 8 inputs with high and low frequency equalization in each channel. The Console is fitted to include patching facilities, a compression amplifier, a power supply, footage counters, and remote start-stop controls for the synchronous film machines.

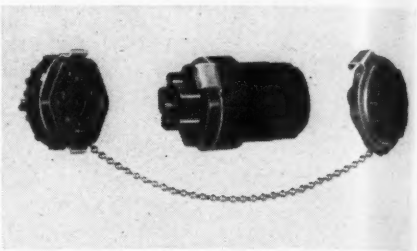


Our staff of experts in the motion picture, disc, and magnetic sound recording fields are available for consultation on special audio equipment problems. We invite your inquiry.

ARLINGTON ELECTRIC PRODUCTS, INC.

18 WEST 25TH STREET, NEW YORK 10, N. Y.

PARTS FOR DESIGNERS

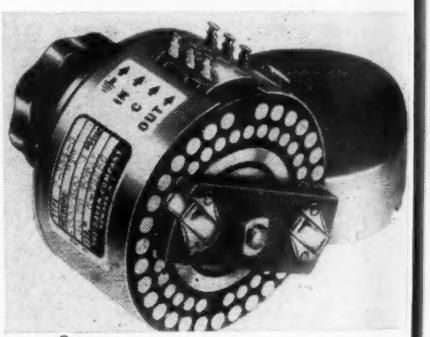


High Voltage Connector

Molded parts are of Melamine in this 6-contact high voltage miniature connector, well adapted to photoflash, aircraft and communications equipment. Contacts are precision machined and silver plated for low contact resistance, freedom from corrosion and ease of soldering. The center contact provides a "make first, break last" connection. Polarization is positive and it is impossible to make contact except in the proper position. Breakdown voltage between contacts is 7000 volts dc.—**Winchester Electronics Co., 6 East 46th St., New York 17, N. Y.**

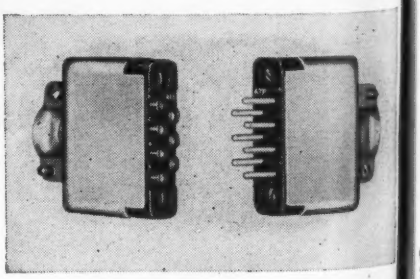
Lead-In Wire

Described as immune to the effects of acids, alkalies and oils, a new television and FM lead-in-wire, has an impedance of 300 ohms and consists of twin parallel copper conductors spaced and insulated with a water-resistant low-loss polyethylene.—**Cornish Wire Co., Inc., 15 Park Row, New York 7, N. Y.**



Switch Rotor

These wiping blades of an entirely different type for rotary switching in attenuators and switches are made of special alloy and are enclosed in a tamper-proof housing. Each blade conductor is individually spring loaded, giving a knee-action effect which results in a uniform pressure on the contacts and slip ring. Stray capacity coupling is decreased, as a consequence of the reduced length of the rotor arm.—**Daven Company, 191 Central Ave., Newark, N. J.**



Lightweight Aircraft Connector

Particularly suitable to military and industrial applications, the 7-contact lightweight aircraft connector has melamine molded parts with telescoping barriers to provide long creepage paths. Contacts are precision-machined and silver-plated for low contact resistanee, freedom from corrosion and ease of soldering. Breakdown voltage between contacts is 7500 volts dc, 5300 volts ac. A 15-contact model is also available.—**Winchester Electronics Co., 6 E. 46th St., New York 17, N. Y.**

MACHLETT ELECTRON TUBES

RADIO TRANSMITTING • INDUSTRIAL • SPECIAL PURPOSE

TRANSMITTING TUBES

Type	Electrodes	Cathode		Max. Anode Rating				Full Input Freq. Mcs.	Mu	Cooling	List Price
		Volts	Amps.	Volts	Ma.	Input Watts	Diss. Watts				
ML-207	3	22.0	52.0	15000	2000	30000	10000	1.6	20	Water	$220.00
ML-846	3	11.0	51.0	7500	1000	7500	2500	50	40	Water	250.00
ML-880	3	12.6	320.0	10500	6000	60000	20000	25	20	Water	440.00
ML-889A	3	11.0	125.0	8500	2000	16000	5000	50	21	Water	190.00
ML-889RA	3	11.0	125.0	8500	2000	16000	5000	40	21	Forced-Air	250.00
ML-891	3	*22.0	60.0	12000	2000	18000	6000	1.6	8	Water	200.00
ML-891R	3	*22.0	60.0	10000	2000	15000	4000	1.6	8	Forced-Air	345.00
ML-892	3	*22.0	60.0	15000	2000	30000	10000	1.6	50	Water	200.00
ML-892R	3	*22.0	60.0	12500	2000	18000	4000	1.6	50	Forced Air	345.00
ML-893A	3	†10.0	61.0	20000	4000	70000	20000	5	36	Water	570.00
ML-893RA	3	†10.0	61.0	20000	4000	70000	20000	5	36	Forced-Air	1050.00
2C-39	3	6.3	1.1	1000	100	100	100	500	85	Forced-Air and Convection	43.40

*Two filament strands in series with large post at neutral junction; operate in series or two-phase.
†Single, three or six-phase filament; voltage is per strand, current is per terminal.

ELECTRONIC HEATING TUBES

Type	Cathode		Max. Anode Rating				Full Input Freq. Mcs.	Mu	Cooling	List Price
	Volts	Amps.	KV	Amps.	Input KW	Diss. KW				
ML-5604	11	176	12.5	3.0	32.5	10	22.5	19.5	Forced-Air	$500.00
ML-5619	11	176	12.5	3.0	32.5	20	22.5	19.5	Water	360.00
ML-5658	12	290	12.5	5.0	60	20	15.0	20.5	Water	455.00
ML-5666	11	120	10	2.0	20	12.5	22.5	21.0	Water	215.00
ML-5667	11	120	10	2.0	20	7.5	22.5	21.0	Forced-Air	280.00
ML-5668	22	60	14	2.0	28	20	5.0	50	Water	235.00
ML-5669	22	60	14	2.0	28	10	5.0	50	Forced-Air	350.00

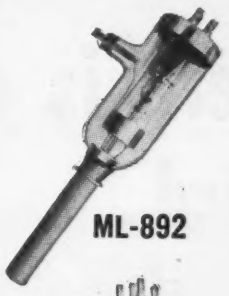
HYDROGEN THYRATRON

Type	Cathode		Max. Anode Rating				Voltage to Fire Grid	Cooling	List Price
	Fila. Volts	Amps.	Max. Pk. Inv. KV	Peak Amps.	RMS Amps.	Aver. MA			
5C22	6.3	10.6	16	325	8	200	175	Radiation	$100

HIGH VOLTAGE RECTIFIERS

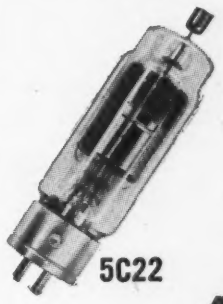
Type	Cathode		Anode Rating		Type of Insulation	Type of Cooling	List Price
	Fila. Volts	Amps.	Max. Pk. Inv. KV	Peak Amps.			
ML-215	10.0	11.5	125	.080	Air	Convection	$ 88.00
ML-203	10.0	11.5	125	.080	Oil	Convection	83.00
ML-210	10.0	11.5	140	.080	Air	Convection	131.00
ML-201	10.0	11.5	140	.080	Oil	Convection	83.00
ML-220	13.0	12.4	140	.160	Air	Convection	131.00
ML-206	10.0	17.8	140	.160	Oil	Convection	131.00
ML-208	13.0	12.4	140	.160	Oil	Convection	131.00
ML-226	13.0	12.4	150	.160	Air	Convection	149.00
ML-5575/100	20.0	24.0	150	1.0	Air	Convection	210.00
ML-5576/200	20.0	32.0	150	2.5	Air	Convection	235.00
ML-270	13.0	12.4	200	.080	Air	Convection	248.00
ML-280	13.0	12.4	200	.080	Oil	Convection	248.00

NOTE: Prices and other data subject to change without notice.

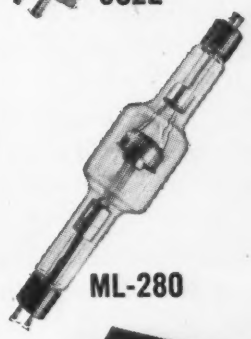


ML-892

ML-5604



5C22



ML-280

A new catalog listing all Machlett tubes, with their applications and ratings, is now available. Ask your nearest representative for your copy or write direct.

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Detroit 24, Michigan

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MACHLETT

Over 50 Years
of Electron Tube Experience
MACHLETT LABORATORIES, INC.
Springdale, Connecticut

here is a bird..

that is..going to be..

HE is in that shell and eventually he is going to hatch out, grow up and be a bird. What kind, we don't know, because we don't know anything about his papa and mamma.

A lot of new things are in the shell right now, on the verge of hatching. Many of them are electrical, requiring various kinds of insulation — in fact, because of insulation, right or wrong, they are going to grow up into real big birds, or, they are going to die of the "pip" before they get their feathers.

We said "because of insulation" — and that is what we meant. Of all the items in the assembly, insulation probably represents the least cost and is of the most vital importance.

Mica is insulation. Mica with the right name in front of it is Mica at its best — MACALLEN MICA.

Whatever goes into the shell (or into the product) is going to come out true to kind. These new electrical devices you are hatching are not going to be a bit better than their insulation.

MACALLEN MICA

ALL FORMS, ALL QUANTITIES — ALL DEPENDABLE

when you think of MICA, think of MACALLEN

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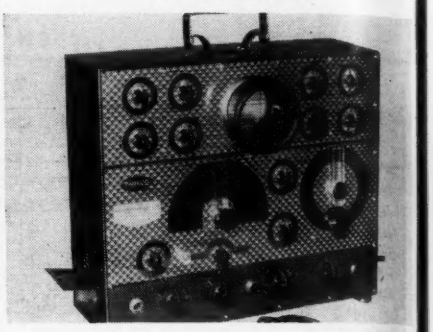
TEST EQUIPMENT

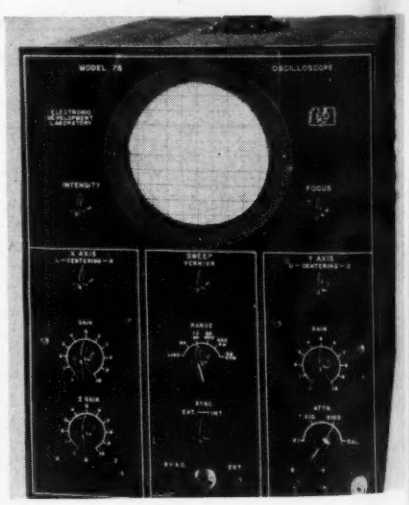


TV and FM Alignment Generator

Attenuation, standing wave ratio, propogation constant and correct terminations of rf transmission lines may be determined with the 7008 visual alignment generator for television and FM. Portable and housed in an attractive steel case, the 7008 operates entirely from the 110-120-volt, 60-cycle ac line and consumes only 70 watts. The following units are incorporated in the instrument: a crystal calibrator to provide accurate check points every 5 mc (and at other calculable frequencies); an AM (marker) generator, operating over a frequency range of 3.2-250 mc; and FM generator, covering an approximate range of 4-120 mc and 145-260 mc with a variable sweep width of 15 mc maximum deviation; an audio frequency generator, operating at 400 cycles; a special oscilloscope; and a common power supply.—**Philco Corp., Tioga and C Streets, Philadelphia, Pa.**

Signal Generator

Tunable form 40 to 400 mc, model 30 is a signal generator which has a 5-watt nominal rf output and 50-ohm impedance with a 160-db range of attenuation (15 volts to 10 microvolts). The spiral dial scale is nearly 4 ft. long and is calibrated at intervals of 1% in frequency. Leakage fields are less than .1 microvolt/meter.—**Rollin Co., 2070 N. Fair Oaks Ave., Pasadena 3, Calif.**



Oscilloscopes

Direct observation of the composite video signal is facilitated by model 75 wide range oscilloscope (illustrated), an instrument with a self-contained voltage calibrator accurate to ±5%. Test probe has shielded cable to eliminated stray pickup and sweep frequency ranges from 10 cycles to 60 kc.

Amplifiers are compensated to give high frequency sine and square wave response in the model 49-A 5-in. cathode ray oscilloscope. A multi-vibrator sweep circuit is provided and maximum peak input potential on either horizontal or vertical circuits is 400 volts. Terminals at rear of instrument provide low capacitance connections direct to deflecting plates.—**Electronic Development Laboratory, 2655 W. 19th St., Chicago, Ill.**

Admiral LEADS AGAIN!

. . . *with this thrilling new* ADMIRAL FM-AM Radio-Phonograph, Television *can be added whenever wanted!*

The greatest idea yet to help you sell *complete* home entertainment . . . especially to keep radio-phono sales at volume levels without danger of obsolescence. Makes it easy to sell Admiral FM radio-phonographs *now*...with or without television. The customer with a limited budget can add the matching television unit later. The same holds true in markets that currently have no television stations.

New "ratio-detector" FM circuit that eliminates noise between stations and makes tuning simple as AM . . . "Miracle tone arm, *the greatest improvement in record playing since the invention of the phonograph* . . . outstanding features like these have made Admiral the hottest line on the market today. You'll find comparable selling "hits" in Admiral "Magic Mirror" Television. Your Admiral distributor has complete details.

RC9B14 Admiral Record Album Cabinet. Walnut.

32.95

9B14 Admiral FM-AM Automatic Radio-Phonograph with "ratio-detector" FM and "Miracle" tone arm. Walnut.

299.95

30A14 Admiral "Magic Mirror" Television with 10" Kinescope tube. Walnut.

299.95

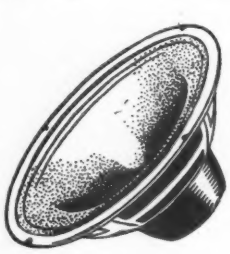
Mahogany and Blonde cabinets slightly higher. Small increase in prices in south and far west.

SURVIVAL OF THE FITTEST

PUSHOUT: No push-over for speakers is this magnet test which checks the strength of the combination of seal and cement up to 1500 pounds.

MEANS FINER SPEAKERS FOR YOU

ONLY the fit survive the stern tests our G-E speakers meet on the production lines. At frequent intervals speakers are picked from the lines and subjected to rigid tests to assure the maintenance of high standards in the manufacturing process. Test after test is applied to single elements, combinations of elements and to the final, completed units. The test shown here is only one of the many that General Electric speakers face as they roll down the production lines. This unceasing care in building speakers of quality builds confidence and customer satisfaction.



Write today for information on General Electric quality speakers to:
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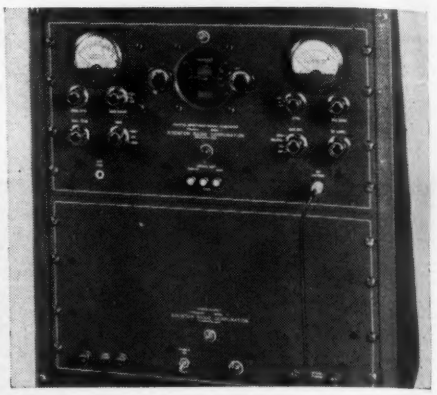
GENERAL ELECTRIC

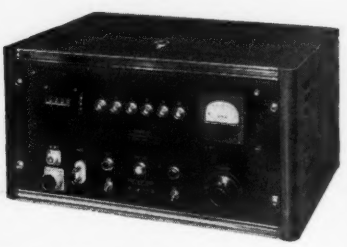
168-G5

TEST EQUIPMENT



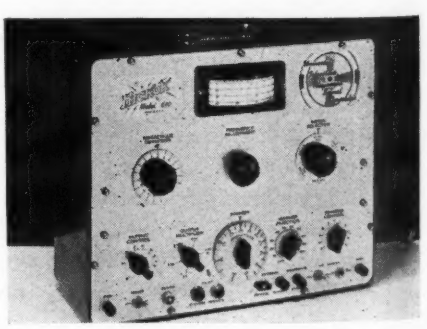
Signal Generator

Testing and calibrating 88-140-mc radio receiving equipment is facilitated by the 211-A signal generator, a unit with a master oscillator accurate to ±0.25%. Accuracy is greatly increased when output frequency is standardized against harmonics of crystal oscillator, operating with either of 2 crystals at 110.10 and 114.90 mc. Operates from 105-125 volts, 50-60 cycles, 160 watts and output is 575 volts dc at 10-135 ma. avg. drain 55 ma., 200 volts dc at 0-65 ma. avg. drain 27 ma., 7.2 volts ac at 2.7 amps.—**Boonton Radio Corp., Boonton, N. J.**



Geiger Counter

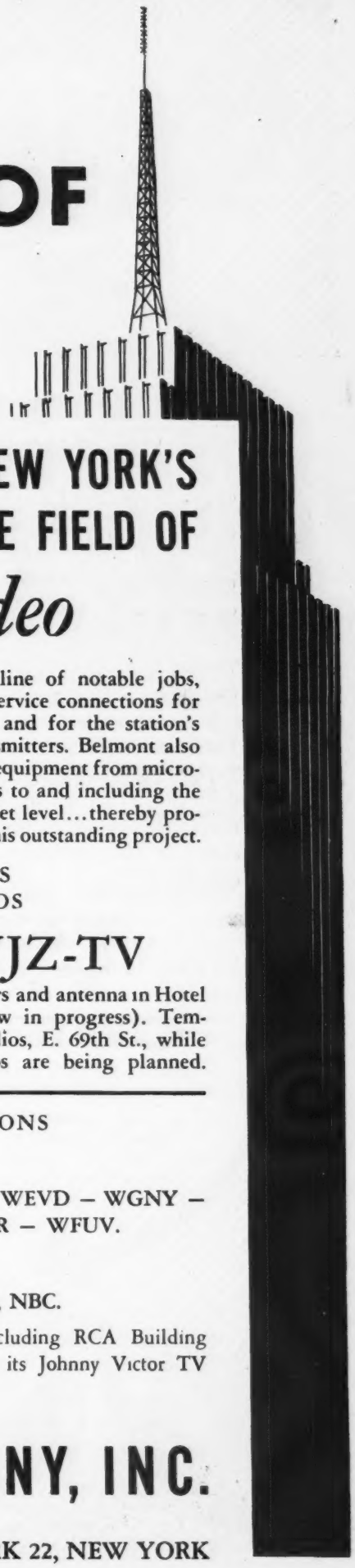
Constructed with a built-in impulse register (recording clock), the LS 64 Geiger-Mueller Counter uses the famed Higgenbotham scaling circuit (under license agreement with the U. S. Atomic Energy Commission.) Impulse register which is zero reset type counts to 9999 before recycling.—**El-Tronics, Inc., 2647 N. Howard St., Philadelphia 33, Pa.**



Universal Television Alignment Generator

The new Hickok Model 610 Television Alignment Generator permits the operator to visually align receivers to any of the TV channels from 44 to 216 mc. Self contained marker frequencies are directly calibrated on a 9½ in. scale and can be inserted at any point along the IF response curve. A crystal controlled frequency, modulated or unmodulated, from 1 to 216 mc is obtainable. Model 610 as a single unit replaces the ordinary television sweep generator used with marker generator, trap alignment generator and crystal calibrator.—**Hickok Electrical Instrument Co., 10528 Dupont Avenue, Cleveland 8, Ohio.**

THE "LIFE LINES" OF WPIX



ANOTHER NOTABLE INSTALLATION BY NEW YORK'S LEADING ELECTRICAL CONTRACTOR IN THE FIELD OF

Radio • Audio • Video

There is no substitute for experience in this highly specialized field!

Twenty years of experience by this progressive organization that has kept abreast of this fast moving industry has made Belmont Electric Company the "first-choice" contractor for radio, audio and video installations in the New York area.

In this latest of its long line of notable jobs, Belmont installed electric service connections for special lighting of studios and for the station's studio equipment and transmitters. Belmont also wired for and connected all equipment from microphone outlets in the studios to and including the antenna, 750-feet above street level...thereby providing the "life lines" for this outstanding project.

REPRESENTATIVE BELMONT INSTALLATIONS
OF TELEVISION TRANSMITTERS AND STUDIOS

WNBT

Original transmitters, studios and antennas on top of the Empire State Building. Most recent Rockefeller Center Studios.

WABD

Studios and master control in the John Wanamaker Store. Transmitter and antenna, Madison Avenue at 53rd Street.

WJZ-TV

Transmitters and antenna in Hotel Pierre (now in progress). Temporary studios, E. 69th St., while new studios are being planned.

OTHER OUTSTANDING BELMONT INSTALLATIONS
IN THE RADIO AND AUDIO FIELD

AM & FM STATIONS: – WMCA – WNEW – WNYE – WAAT – WEVD – WGNY – WINS – WOV – WPAT – WQXR – WNJR – WFUV.

RADIO STUDIOS: – ABC – WHOM – WOV – WNEW.

FILM & DISC RECORDING STUDIOS: – RCA, Fox, Ideal, MGM, NBC.

The entire sound and broadcast installation at the New York World's Fair, including RCA Building complete with its television facilities. The new RCA Exhibit Hall, complete with its Johnny Victor TV and Broadcast Theater.

Consultation Without Obligation

BELMONT ELECTRIC COMPANY, INC.

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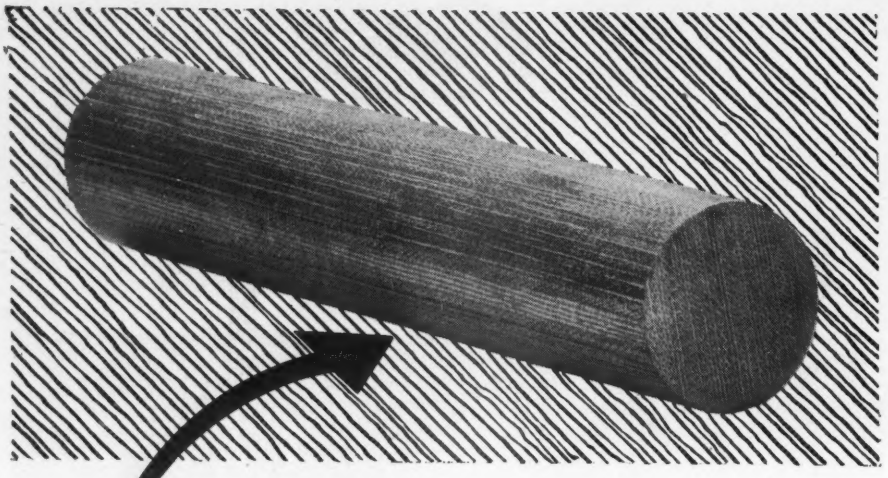

FROM ROD STOCK TO SUPPORT BLOCK

That smooth cylinder of Taylor Phenol Fibre pictured above doesn't appear very complex.

But with a few deft motions in the machine shop, it becomes the hinge support block shown below . . . intricate, carefully engineered, highly specialized.

Sheets, rods, and tubes of Taylor Laminated Plastics, in various formulations, are serving industry in more ways every day. Their machineability is a paramount factor.

For a dependable source of supply for Phenol Fibre, Vulcanized Fibre, or special laminates . . . get in touch with Taylor. For fabricating service, too . . . with on-schedule deliveries . . . depend on Taylor. You'll get the kind of service that eliminates production headaches. As a starter, send a sketch or blueprint today. We'll tell you exactly what we can do for you.

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LAMINATED PLASTICS: PHENOL FIBRE • VULCANIZED FIBRE
Sheets, Rods, Tubes, and Fabricated Parts
NORRISTOWN, PENNA.
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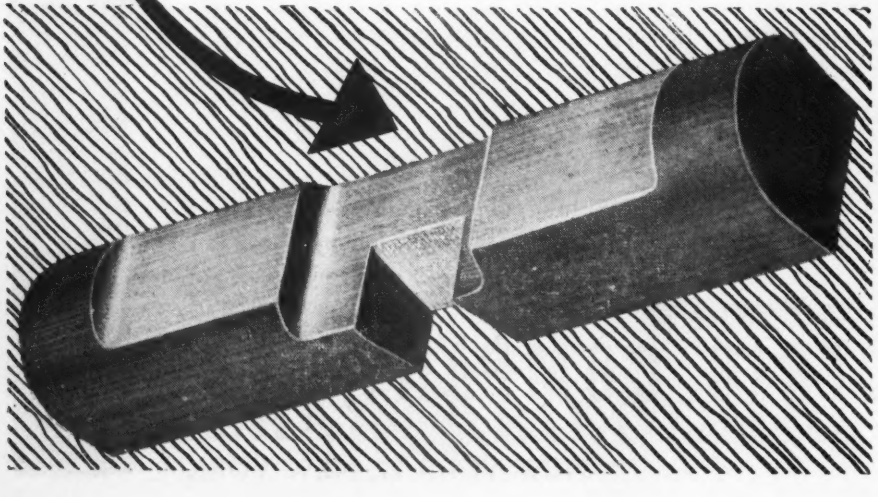
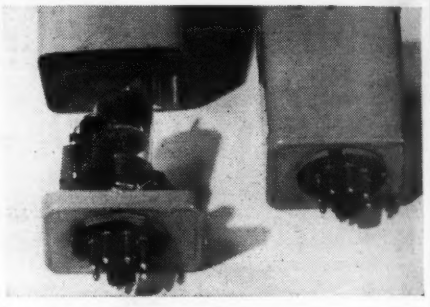


SOUND EQUIPMENT

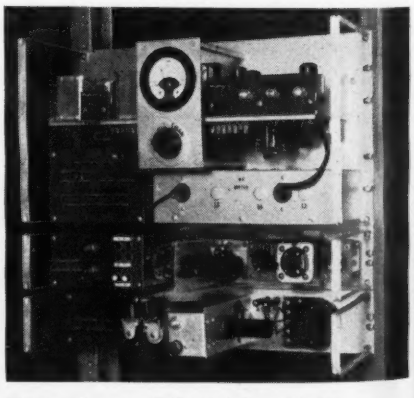
Disc Recorder

Speed change from 78 to 33⅓ rpm is simple and instantaneous with the Rek-O-Kut Challenger 12-in. disc recorder. It is no longer necesary to turn over the idler, remove a motor pulley or readjust a motor to change speeds. The unit incorporates an 8-in. speaker baffled for maximum effectiveness and a self oiling system that maintains complete and efficient lubrication on all moving parts.—**Rek-O-Kut C.o, 38-01 Queens Blvd., New York.**



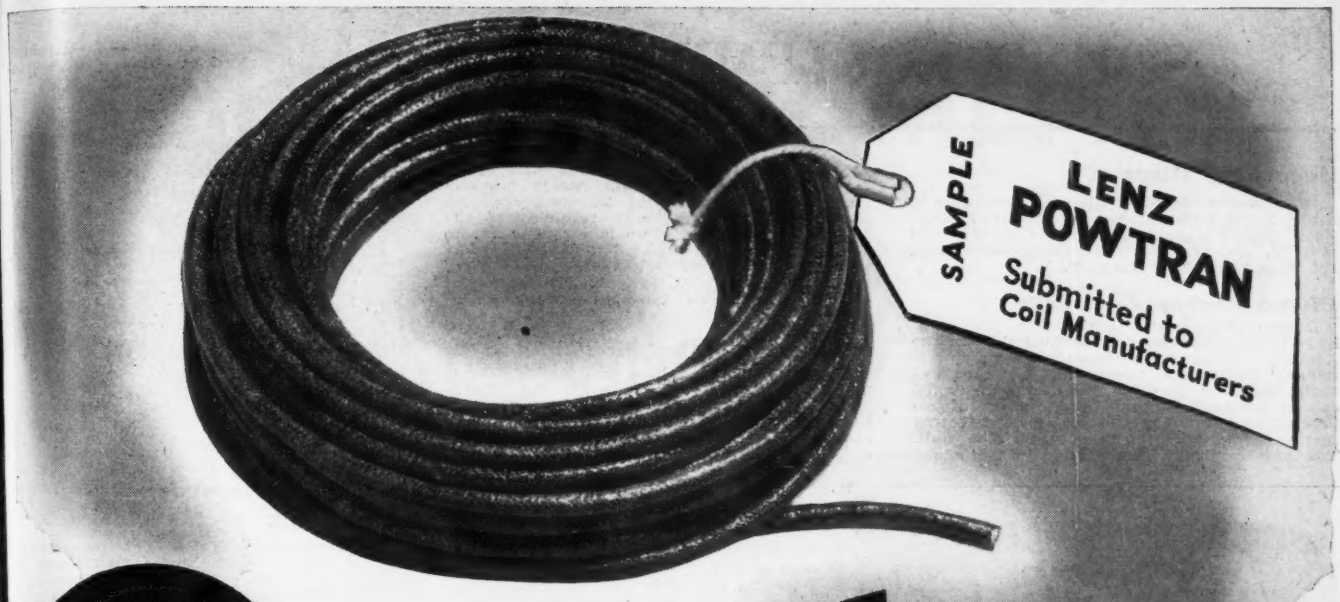
Amplifier-equalizer

An amplifier-equalizer stage, designed to compensate for the bass characteristics of GE variable reluctance, Pickering and other types of magnetic pickup cartridges is announced. Model 1A, contained in a small metal shield can, plugs into a standard octal socket that is connected between the phonograph input and the grid of the input tube. Operating power requirements are: 6.3 volts at 0.3 amp. and 250 volts at 2 ma well filtered B plus. Output voltage is 0.5 to 1 volts with less than 1% distortion. An adapter plug is also available allowing for immediate conversion back to a crystal pickup.—**Collins Audio Products Co., Mountainside, New Jersey**



Telephone Pilot Regulator

Attenuation and twist are corrected rapidly, smoothly and continuously by the Lenkurt all-electronic pilot regulator which occupies only 10½ in. of rack space and combines automatic level control with automatic slope equalization. The pilot oscillator and alarm occupy 2 additional 3-in. panels and, for convenience, can be mounted remotely. Corrections are made to 2 db or less in 20 db variations. The regulator makes complete recovery from a sudden 20 db attenuation in 4 seconds as compared to about 16 minutes for motor driven type regulators.—**Lenkurt Electric Co., 116 County Rd., San Carlos, Calif.**



LENZ powtran

FOR POWER TRANSFORMER LEADS

- **Withstands coil impregnation temperatures without electrical or mechanical deterioration**
- Textile Insulation rated at 90° operating temperature
- 4100 volts breakdown one foot immersed in Mercury
- Available in RMA Transformer Lead Color Code— Sizes 22 to 14
- Flame Resistant
- Easy Stripping

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Please send me sample and specifications of POWTRAN.

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LENZ ELECTRIC MANUFACTURING CO.

SOUND EQUIPMENT

Recording Discs

Professional recording discs are available in the 1, 2 and 3-star blanks in 10, 12 and 16-in. sizes. Master discs in sizes of 11⅞, 13¼ and 17¼ in. are available also.—**Recordisc Corp., 395 Broadway, New York, N. Y.**

Phono Pickup Cartridge

Delicately spaced, troublesome air gaps have been eliminated for the first time in the Astatic "Magneto-Induction Pickup Cartridge." Heretofore, presence of air gaps and their tendency to collect lint and dust had caused gradually diminishing quality of reproduction in magnetic pickups, defeating certain basic advantages of this type unit. The new cartridge is available in 2 models: the MI-1 with standard housing, and model MI-2 with Mumetal housing which provides increased shielding effect for maximum reduction of hum. Velocity response of the Magneto-Induction Pickup is given as flat to 12,000 cycles, output 100 millivolts. Needle pressure is 1 ounce. It has an impedance of 7500 ohms at 1000 cps, 110,000 ohms at 10,000 cps.—**Astatic Corp., Conneaut, Ohio**

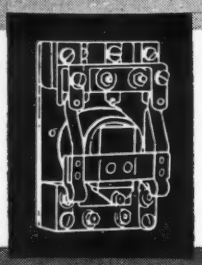
Phase Modulated Microphone

Carrier frequency phase modulation is employed in the Tru-Sonic model C-1 microphone, a new unit which features absolute linearity, no distortion, no arc-over or breakdown and pressure operation at all frequencies. Pick-up unit contains the acoustic valve and carrier matching coil.—**Stephens Mfg. Corp., 10416 National Blvd., Los Angeles 34, Calif.**

Proved in Millions of Applications!

WARD LEONARD

RELAYS RESISTORS RHEOSTATS

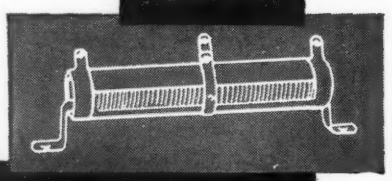


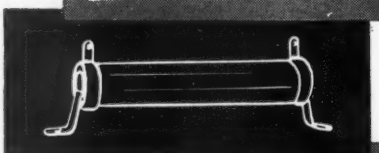
Vast Variety of Stock Units

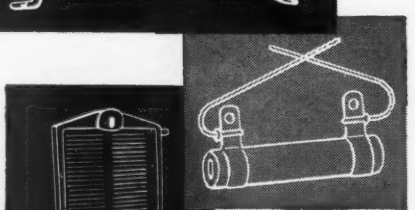
ANSWERS EVERYDAY NEEDS ECONOMICALLY

Relays are available from stock in general-purpose, industrial, and radio amateur types for continuous or intermittent duty.

Vitrohm wire-wound Fixed Resistors are available in 8 stock sizes from 5 to 200 watts. Adjustohms in 7 stock sizes from 10 to 200 watts. Plaque Resistors in 3 sizes from 20 to 125 watts. Discohms in 18 watts. Stripohmn in 5 stock sizes from 30 watts to 75 watts. Ring-type close control Rheostats in 4 stock sizes from 25 to 150 watts. (Plate Type Rheostats recommended for larger sizes.) Wide variety of Resistance Values.







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Radio & Electronic Distributor Division

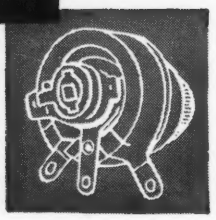
53-M West Jackson Blvd., Chicago 4, U.S.A.

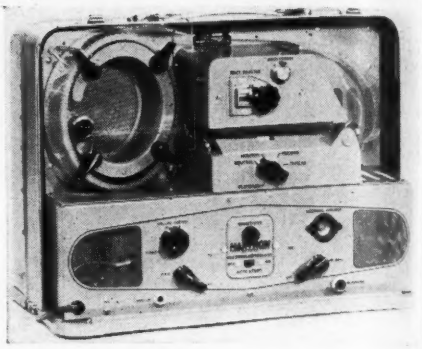
SEND FOR HELPFUL CATALOGS

Catalog D-30 gives complete data and listings on stock units available in Resistors, Rheostats and Radio Amateur Relays. *Catalog D-20* lists Industrial and General-Purpose Relays. *Write for them today!*

WARD LEONARD

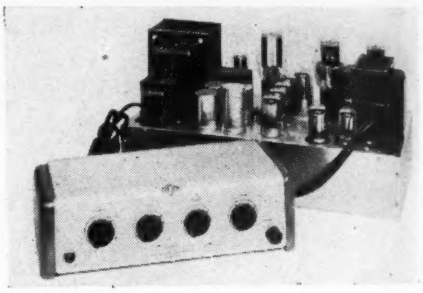
Basic 3R's in Current Control





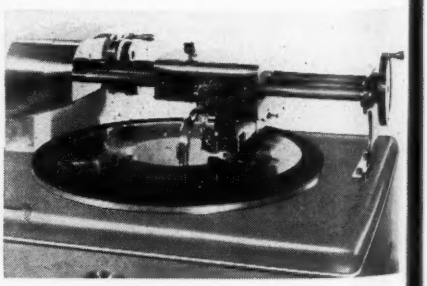
Film Sound Recorder-Reproducer

An all-purpose, light-weight recorder-reproducer, the Hartron model 60, utilizes 35 mm film to produce a permanent, 2 hour, non-erasable sound record. All adjustments may be made on outside control panel. Track indicator quickly locates any part of recording for playback purposes and easy, straight-line loading of film facilities quick film changes. Auto start-stop, a voice actuated mechanism, automatically starts and stops the machine at any voice level.—**Frederick Hart & Co., Inc., Poughkeepsie, N. Y.**



Audio Amplifier

Consisting of 2 separate units, the 10C3 high- quality amplifier is designed for remote operation with all controls conveniently removed from the basic amplifier. The smaller of the 2 chassis contains the pre-amplifier stages, input jacks and all operating controls. The larger chassis houses the 30-watt power amplifier and power supply. One of the 4 input channels provided has a high gain with internal equalization for use with low-level magnetic-type pickups. Frequency response is flat within 0.2 db from 20 to 20,000 cycles.—**Brook Electronics, Inc., 34 DeHart Place, Elizabeth 2, N. J.**



Lathe Type Recorder

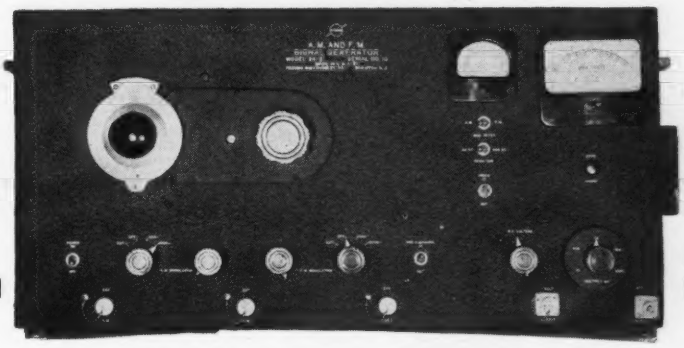
A perfected belt drive and dynamically balanced components in the Robinson lathe type recorder have reduced the "wow" factor to .01% at 78 and 33 1/3 rpm. The highly precise ground thread feed screw completely eliminates the usual "feed screw pattern." Pitches of 88, 96, 112, 120, and 128 lines per in. are available with inside or outside start. An accurate diameter scale, built-in mercury switch and convenient lift levers are designed for fast operation and the cutter carriage will accomodate any type of cutter —**Robinson Recording Laboratories, 2022 Sansom St., Phil. 3, Pa.**

FERRIS INSTRUMENTS

— Introducing an —

OUTSTANDING NEW UNIT

THE MODEL 24B SIGNAL GENERATOR WITH AM-FM AND PROVISION FOR VIDEO MODULATION



SEVEN EASILY CHANGED FREQUENCIES IN THE RANGE FROM 5 to 220 MCS

FOR LABORATORY FOR PRODUCTION

Check These Features

1. Modulated R.F. Amplifier
2. Amplitude Modulation to 50%
3. Frequency Deviation to ±250 kc
4. Built in Video Amplifier
5. Rise time less than 0.2 u.s.
6. Manual ±2% Frequency Control
7. Internal ±10% Frequency Adjustment
8. Modulation Meter A.M. and F.M.
9. Manual Modulation Controls
10. Separate A.M. and F.M. Modulators
11. Modulation 400 — 1000 + External
12. Output 0.1 uv to 1.0 volt
13. D.C. on Critical Heaters
14. Four Inch Output Meter
15. Type "N" Connectors
16. 50 ohm Output Impedance
17. Dummy Antenna Included
18. Extra Line Filter
19. Size: 30" W. x 14" H. x 10" D.
20. Weight: 45 lbs.

There is no guess work with this instrument as all functions are controllable and indicated. The use of an R.F. amplifier eliminates reaction of output controls on frequency. The video amplifier permits checking of television production with monoscope or pulse signals. Write for additional details and quotation.

FERRIS

FERRIS INSTRUMENT COMPANY

110 CORNELIA STREET, BOONTON, N. J.

BRIDGED CIRCUITS FOR POLICE RADIO

(*Continued from page 29*)

circuit to the zone bridge, and additional equipment includes a 3-way key and an auxiliary loudspeaker. Each zone bridge actually consists of 3 bridges, to one of which, called the "radio bridge," is linked a circuit from each of the zone's radio stations. The network circuits from every sub-station and from troop headquarters connect to relay springs with a back contact connecting with an output bridge and a front contact connected with an equalizing pad.

When a land radio station has been connected into the network by its remote control station, a signal arriving at the receiver passes through its control station to the radio bridge section of the zone bridge. From here it passes through an amplifier forming part of a reversing pair, thence through an intermediate bridge to a power amplifier, and then to the output bridge, where it is distributed by the network to all sub-stations — including the control station — and also to the circuit to the troop bridge.

The 3-way key at remote control stations enables the operating trooper to (1) use the radio facilities without the network, (2) use the network without the radio facilities, and (3) link the radio to the network, making the combined facilities available to all zone sub-stations and higher headquarters.

When the radio station and the network are not connected, the auxiliary speaker stands guard to bring in any messages on the facility the trooper-operator is not using. Then the trooper throws the key to "radio only," his console loudspeaker connects with the circuit to the radio station and the guard speaker connects with the network circuit. When he throws the key to the position permitting him to talk over the network without going on the air, it switches the guard speaker to the radio station circuit and his console speaker to the network.

At the troop bridge the circuits from the zone bridges connect through reversible amplifiers with individual relay springs whose back contacts normally connect each zone network with its monitoring loudspeaker in troop headquarters. Key-equipment in the headquarters permits operating any or all of these relays to throw the circuits into the troop bridge, enabling troop or Albany headquarters to talk with any or all of the zones.

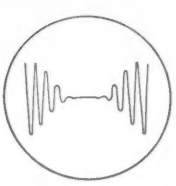
Another reversible amplifier connects the troop bridge with the circuit to the Albany bridge, which is similar to a troop bridge, except that instead of an individual loudspeaker for each troop network, there is key equipment which permits the selection of any or all troop networks for monitoring. A person in the Albany headquarters wishing to talk over the network asks an operator for the troop or troops desired, and each troop circuit is transferred through its relay to the Albany bridge. It the person wishes to talk to a particular zone, troop headquarters operates the key connecting the zone network desired.

DISPLAYS MIS-MATCH

over wide frequency range

The **MEGA-MATCH**

For Visual Display of Reflected Energy



- 10 to 250 MC and up. Complete television and FM coverage.
- Completely electronic. No slotted lines, moving parts, bridges, or other frequency sensitive devices such as directional couplers.
- Precision frequency meter.
- Saves engineering time—Visual display presents instantly data which would take hours to tabulate.
- Can be adapted for balanced lines.

Completely Electronic

This unique instrument presents a visual display of REFLECTED energy over any band up to 30 MC. By the use of the MEGAMATCH it is possible to instantly observe and measure mismatches. Thus this instrument will check transmission lines, antennas, input and output impedance of amplifiers, converters, transformers, etc.

Price: $695 F.O.B. FACTORY

KAY ELECTRIC CO., 25 Maple Ave., PINE BROOK, N. J.

For TV stations...TV engineers...TV suppliers

TELEVISION by hallicrafters

Only **HALLICRAFTERS**
gives you Push-Button Tuning on all 13 Channels.

- √ 7" electrostatic tube, providing picture with perfect clarity.
- √ Direct view, sharp, brilliant pictures.
- √ Inter-carrier modulation type FM sound system.
- √ Automatic gain control circuit controls IF system to maintain constant reception.
- √ Three stages of IF, using iron-core transformers.
- √ Built-in 4" x 6" dynamic speaker.
- √ 19 tubes plus cathode ray tube and 3 rectifiers.
- √ Housed in gray and black satin-finish steel cabinet.
- √ Simple, fool-proof operation.

Only **HALLICRAFTERS**
could build such a precision receiver at such a low price.

PRECISION-BUILT for better television and based on the most advanced thinking in TV engineering, the Hallicrafters model T-54 is the perfect television receiver for business or personal use wherever television is put on the air — wherever TV products are made for receivers, transmitters or studio equipment. This new Hallicrafters is ideal for:

$169.50
Model T-54

1. TV stations needing receivers for executive offices, recreation rooms, auxiliary monitoring or other remote viewing.
2. TV suppliers, for offices, laboratories, meeting and reception rooms, etc.
3. Broadcast stations (AM & FM) for competitive observation.
4. Engineers, radio technicians, hobbyists, trained veterans, and radio amateurs who value precision—who know and respect Hallicrafters equipment.

Now Available in All Television Areas
SEE YOUR HALLICRAFTERS DEALER TODAY

THE HALLICRAFTERS CO.
4401 W. 5th Avenue • Chicago 24, Illinois

TWO-COLOR RADAR

(*Continued from page* 67)

circuits measure the time elapsed between the transmission of the challenging pulse and the reception of the response pulse. Other circuits then convert the time difference into a mechanical indication of the distance from the aircraft to the beacon. This sequence of operation is repeated frequently enough to give a smooth and continuous indication.

A beacon responds to all aircraft within range challenging on its assigned frequency channel. Each airborne challenger, therefore, receives the ground beacon's responses to many other challengers, and must have some means of finding and using only the responses to its own pulses. For this purpose, a random variation is intentionally introduced in the repetition frequency at which each airborne challenger's pulses are emitted.

Since the ground beacon's reception of the airborne challenger's signals differs from its reception of ordinary radar reflections it is possible to superimpose both radar signals on one indicator. This was done by overlaying the images of the two scopes (one handling the aided radar and the other the reflected radar signals) through suitable color filter and a half-silvered mirror. Signals from planes equipped with DME service thus stand out on the display as a second color, without cluttering.

At the top of the tower a high scanning speed radar was in use, rotating 60 rpm operating in conjunction with DME, and radar research on the level below. A complete experimental design of a television transmitter was shown on the next lower floor, and experimental setups of a two-way radio mobile communication system were found at still another level in the tower.

The design of the tower presented a number of problems. Foremost among these was the problem of weight distribution. With 75% of the weight concentrated between the 212 and 300-ft. levels, the problem of providing adequate support was a major consideration because of the narrow base. For example, it was estimated by architectural engineers that, during high winds, the uplift stress on the foundation might well run into several hundred tons, and so a tension anchorage was developed, a unique design feature.

The frame of the tower, including the columns and bracing, is made of structural steel of standard rolled shapes. Roof and floor slabs are of reinforced concrete on steel beams, the upper floors employing slightly different framing because of the depressed floors and overhanging balconies.

The south balcony at the lower landing is cantilevered 12 ft. beyond the column supports and the resulting uplift on the main floor girder is reacted by an inverted K-frame to the floor above. The south columns above the main landing, carrying a design loading of over 200 tons, are carried back to the main columns by cantilever girders.

VERY FINEST OPERATION is their UNANIMOUS opinion!

W 5 CNK SAYS . . . "Since installing the BUD VFO, 3213 contacts made on ten meters. 37 zones, 48 states. Less than 2% incomplete contacts. NOT ONE SINGLE REPORT OF SIGNAL DRIFT."

W 4 FNQ SAYS . . . "the BUD VFO is way ahead in stability . . . have been able to work consistently into Cuba, Bahamas and around the state . . . reports almost invariably T9X."

W 4 JIH SAYS . . . "I have owned and used a BUD VFO-21 since they came on the market with very good results . . . I would like to take this opportunity to congratulate you on the design of BUD equipment. I use your products throughout my rig and like them for the simplicity of design . . . Tnx for building equipment for the hams."

These unsolicited testimonials make us mighty proud of our VFO-21. Why shouldn't it be just as fine for you as for these hams and the many others who have written to us? This is your chance to buy a fine variable frequency oscillator at a low cost. The BUD VFO-21 is available at $52.50 net including a set of 40 meter coils. Coils for other bands available at $4.00 per set.

THE BUD RADIO INC. LINE OF RADIO AND ELECTRONIC COMPONENTS IS COMPLETE ENOUGH TO SATISFY INDUSTRIAL REQUIREMENTS AND THOSE OF THE ELECTRONIC ENGINEER AS WELL AS THE RADIO AMATEURS.

Visit Bud Booth No. 131 at the National A.R.R.L. Convention, Milwaukee, Wisc., Sept. 4-6-1948

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This coupon is the key to the new lower prices in BUD Products.
BUD RADIO, INC., 2124 East 55th St., Cleveland 3, Ohio. Send copy of NEW BUD CATALOG.
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COMPANY .....
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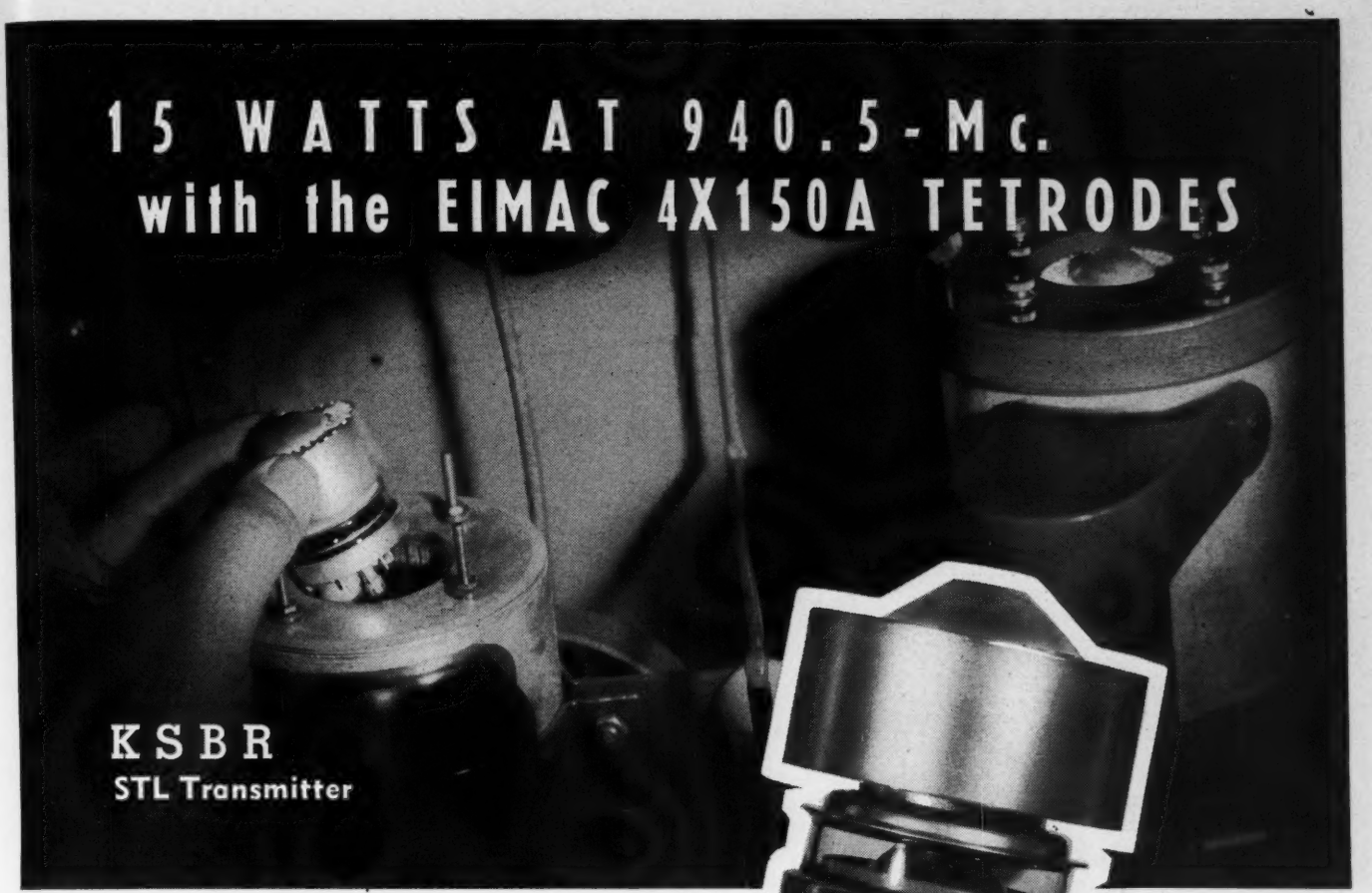
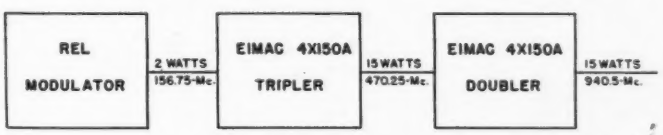
15 WATTS AT 940.5-Mc. with the EIMAC 4X150A TETRODES



FREQUENCY UP 6X, (156.75-Mc. to 940.5-Mc.)
POWER UP 7X (2 watts to 15 watts)

Here's a STL transmitter that's in operation on the new 950-Mc. band, fulfilling all the FCC requirements and powered by Eimac 4X150A tetrodes. It's a part of the studio-transmitter-link between the San Bruno studios and the 250 Kw FM transmitter of station KSBR high atop 3849-foot Mt. Diablo some 33 miles away.



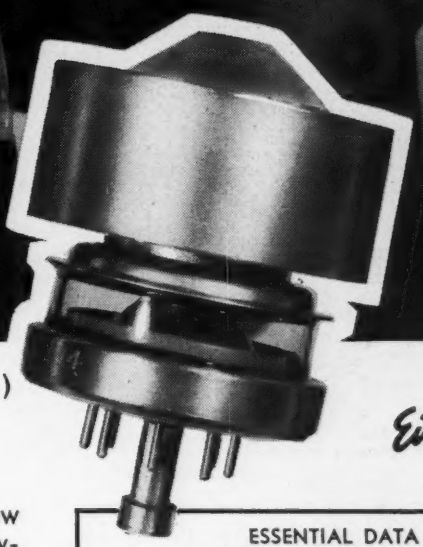
The R-F amplifier was specifically designed for the KSBR application by Eimac engineers. It is driven by an REL modulator delivering 2 watts output at 156.7-Mc. to one Eimac 4X150A in a tripler stage, which in turn drives a single 4X150A in a doubler stage, providing 15 watts useful output at 940.5-Mc.

The Eimac 4X150A is ideally suited for this application because of its high power gain at relatively low plate voltages, ability as a frequency multiplier without loss of amplification, low grid drive requirements, and a high ratio of transconductance to capacitance. It also has the advantage of being physically small and functionally designed for simple installation.

Complete data on the Eimac 4X150A for STL and other UHF applications is available by writing direct.

EITEL-McCULLOUGH, INC.
197 San Mateo Avenue, San Bruno, California

EXPORT AGENTS: Frazar & Hansen—301 Clay St.—San Francisco, Calif.



Eimac 4X150A

ESSENTIAL DATA
KSBR STL TRANSMITTER

REL MODULATOR, MODEL 694
EIMAC 4X150A, R-F AMPLIFIER

Useful Output Power	15 watts
Frequency	940.5 Mc.
Frequency Stability	.002%
Audio Frequency Response.	
Substantially flat	50 to 15,000 cycles
Distortion	.5% Max.
Noise Level	70 db below 100% modulation
	± 100 Kc. deviation

Eimac 4X150A
General Characteristics

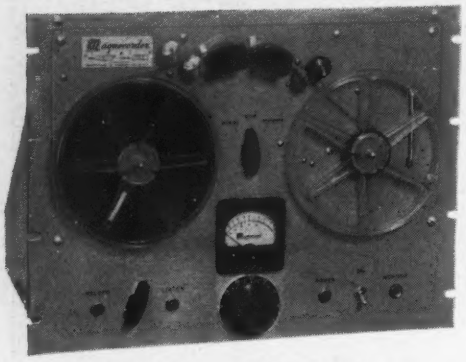
Heater voltage	6.0 volts
Heater current	2.8 amps.
Minimum heating time	30 secs.
Grid Screen amplification factor	4.5
Direct interelectrode capacitance (Average)	
Grid-Plate	0.02 μμf
Input	14.1 μμf
Output	4.7 μμf

Maximum Ratings

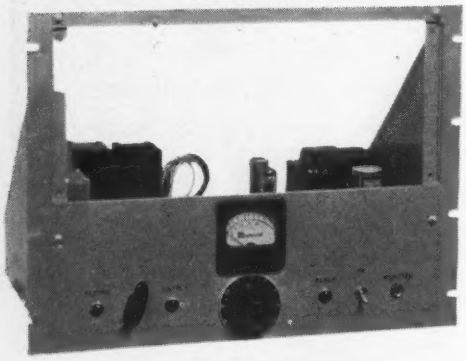
D-C Plate voltage	1000 volts
D-C Plate current	250 ma.
Plate dissipation	150 watts
D-C Screen voltage	300 volts

Follow the Leaders to
Eimac TUBES
The Power for R-F

ONLY THE NEW *Magnecorder*



Series PT6-A, the basic Recorder unit, combined with Rack Mount Amplifier, PT6-R, for studio application.



Series PT6-R Rack Mount Amplifier before Recorder PT6-A is applied.

Series PT6-P, Portable Mixer-Amplifier and cover, shown with basic Recorder mounted in carrying case for portable field operations.

GIVES YOU

ALL

OF THESE FEATURES IN A FM QUALITY professional

TAPE RECORDER

•

Magnecorder unit construction and plug-in design using four basic units, broadens recording possibilities and simplifies the technique in studio, field, laboratory or institution.

Magnecorder combines fine FM quality and extreme VERSATILITY —

PORTABLE
STUDIO
CONTINUOUS
REMOTE

— and LOW COST, within the means of the smallest broadcaster.

•

Magnecord manufactured the first professional high fidelity, magnetic wire recorder and now has perfected this high fidelity tape recorder of unit design to fit any application.

Send for descriptive bulletin giving complete details and name of nearest representative.

MAGNECORD, INC.

360 North Michigan Avenue
Chicago 1, Illinois

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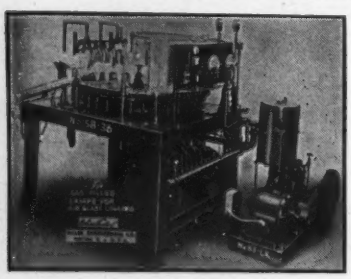
SPECIALIZES IN EQUIPMENT FOR THE COMPLETE MANUFACTURE OF



36 HEAD RADIO TUBE EXHAUSTING MACHINE WITH BOMBARDER

INCANDESCENT AND FLUORESCENT LAMPS, LUMINOUS NEON, RADIO, X-RAY, TELEVISION, AND ELECTRONIC TUBES OF ALL TYPES

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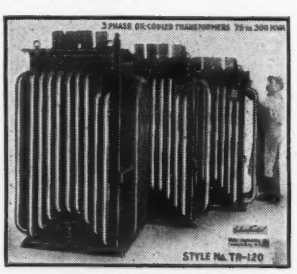
SPOTWELDERS SIZES FROM ¼ TO 250 KVA BUTT, GUN, ARC WELDERS

Large or Small Contract Spot and Butt Welding. Ask for Our Catalog



TRANSFORMERS FOR EVERY SERVICE FROM ¼ TO 250 KVA SPECIAL TRANSFORMERS FOR ELECTRONIC DEVICES

EISLER ENGINEERING CO., INC., 778 So. 13th St., NEWARK 3, N. J.

TV Receiver Distribution Shown by States

The Radio Manufacturers Association report showing shipment by areas of television receivers during 1947 and the first quarter of 1948 indicates 286,317 sets went to 27 states and the District of Columbia. State distribution for the 15-month period was as follows:

California: 16,320; Connecticut: 4,761; Delaware: 413; Dist. of Col: 8,320; Florida: 41; Georgia: 6; Illinois: 20,735; Indiana: 521; Kansas: 1; Kentucky: 11; Maryland: 6,991; Massachusetts: 4,365; Michigan: 7,501; Minnesota: 1,773; Missouri: 6,205; Nebraska: 1; New Jersey: 39,072; New Mexico: 55; New York: 99,946; N. Carolina: 2; Ohio: 8,178; Pennsylvania: 30,204; Rhode Island: 10; Tennessee: 15; Texas: 6; Utah: 25; Virginia: 1,057; Wisconsin: 4,082.

An additional 7,800 receivers were shipped to areas not reported above. To this number should be added receivers shipped during April, May and June. These totals are shown (except for June not yet available) in the "Box Score" published monthly by TELE-TECH.

Commercial Fax Authorized

Effective July 15, commercial facsimile service may be inaugurated by FM broadcast stations, according to an FCC authorization issued last month. However, transmission may not exceed one hour during the period between 7:00 a. m. and midnight and may not be counted toward the minimum operating time required by the FCC of each station.

Engineering standards amended accordingly are:

Left to right progressive rectilinear scanning shall be employed at the rate of 360 scanning lines per minute. With a scanning cycle, the unused interval (45°) is divided into 3 equal parts, the first and third being used for transmission at approximately white level, the second 15° for transmission at approximately black level.

Amplitude modulation of subcarrier shall be used, varying approximately inversely linearly with the optical density of the subject copy, (maximum subcarrier amplitude and maximum radio frequency swing on black).

Smallest TV Receiver

The smallest television set on the market is purported to be the recently announced Pilot Radio Corp. receiver equipped with a 3-in. RCA 3KP4 picture tube. The set has 20 tubes, 12-channel tuning and 4 operating controls. Named the "Candid TV," the receiver measures 14 x 13½ x 9½ in. and weighs 15 lb. Priced to retail at $99.50, it is the first television receiver on the market to break the less-than-$100 price range. The receiver was designed by Pilot's chief engineer, Dr. W. F. Auerbacher, whose object was to create a "personalized" TV set. Full production is expected to get under way in about 6 weeks.

Lodge Upped by CBS

William B. Lodge has been upped to vice-president in charge of general engineering of Columbia Broadcasting System.

Helipot

Trademark of the **HELIcal POTentiometer!**

THE REVOLUTIONARY Potentiometer that Gives You 46½" of Slide Wire in a Panel Space 1½" in Diameter!

Throughout the electronic industry — wherever quality electronic instruments are designed, manufactured or used—the big news is HELIPOT, the helical potentiometer-rheostat that is making possible entirely new standards of accuracy, convenience and compactness in modern electronic equipment. Briefly, here's what makes the *Helipot* so unique . . .

*Instead of a single partial turn of slide wire as found in the conventional potentiometer, the Helipot has many full turns of slide wire coiled into a compact helix requiring no more panel space than the ordinary potentiometer. The sliding contact follows the long helical path of the slide wires from end to end when a single knob is rotated. Thus, the Helipot requires the same panel space—the same single control knob—as a conventional potentiometer . . . yet it provides the wide range control and accuracy of a slide wire approximately twelve times as long.**

In other words, whereas the conventional rheostat gives approximately 300° of rotation, the 10-turn Helipot gives 3600° of rotation in the *same* panel space. Think what this important advancement can mean in simplifying the control, increasing the convenience and improving the accuracy of *your* electronic equipment. Helipots are already being used in a wide range of devices—depth sounding equipment, flight control instruments, electrical computors, strain-gage circuits, oscilloscopes and other indicating and measuring apparatus, and a great variety of other electronic applications. Let our engineering staff study *your* control problem and show you how Helipots can increase the accuracy, utility and simplicity of your equipment. There's no obligation, of course.

*For the standard 10 turn, 1½" unit. Other sizes proportional. We are also equipped to supply other types of potentiometer-rheostats. Send us your requirements.

A SIZE FOR EVERY APPLICATION!

Helipots are available in a wide range of sizes and types to meet varying application requirements. Standard Helipots include the following . . .

Model A — Case diameter — 1.8"; Number of turns — 10; Slide wire length — 46½"; Rotation — 3600°; Power rating — 5 watts; Resistance ratings — 10 to 50,000 ohms.

Model B — Case diameter — 3.3"; Number of turns — 15; Slide wire length — 140½"; Rotation — 5400°; Power rating — 10 watts; Resistance ratings — 50 to 200,000 ohms.

Model C — Case diameter — 1.8"; Number of turns — 3; Slide wire length — 13½"; Rotation — 1080°; Power rating — 3 watts; Resistance ratings — 5 to 15,000 ohms.

In addition, special models of Helipots in production include . . .

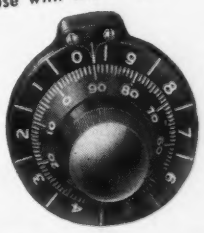
Model D — Case diameter — 3.3"; Number of turns — 25; Slide wire length — 234"; Rotation — 9000°; Power rating — 15 watts; Resistance ratings — 100 to 300,000 ohms.

Model E — Case diameter — 3.3"; Number of turns — 40; Slide wire length — 373"; Rotation — 14,400°; Power rating — 20 watts; Resistance ratings — 150 to 500,000 ohms.

Write for data on the

DUODIAL

. . . the ideal turns-indicating dial for use with the Helipot!



Compact, simple and fool-proof, here's a dial that requires no more panel space than conventional dials. Yet it contains two concentric dials — a Primary dial that indicates rotational position of the slider . . . and a Secondary dial that shows number of complete revolutions of the Primary dial. Available in a wide range of turns-ratios for all sizes of Helipots — and for other helical applications.

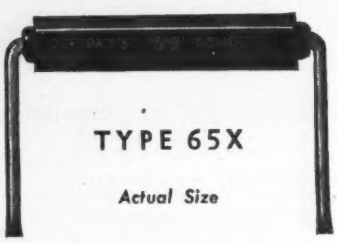
Send for descriptive details!

Send for Helipot booklet!

THE Helipot CORPORATION, 1011 MISSION STREET, SOUTH PASADENA 3, CALIFORNIA

MOLDED
S·S·White RESISTORS
The "All-Weather" Resistors

Of particular interest to all who need resistors with inherent low noise level and good stability in all climates



HIGH VALUE RANGE
15 to 1,000,000 MEGOHMS

This unusual range of high value resistors was developed to meet the needs of scientific and industrial control, measuring and laboratory equipment—and of high voltage applications.

STANDARD RANGE
1000 OHMS TO 10 MEGOHMS

Used extensively in commercial equipment including radio, telephone, telegraph, sound pictures, television, etc. Also in a variety of U. S. Navy equipment.

SEND FOR
BULLETIN 4505

It gives details of both the Standard and High Value resistors including construction, characteristics, dimensions, etc. Copy, with Price List, mailed on request.

S.S.WHITE INDUSTRIAL DIVISION
THE S. S. WHITE DENTAL MFG. CO.
DEPT. Q, 10 EAST 40th ST., NEW YORK 16, N. Y.
FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RESISTORS • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

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ZOPHAR
Waxes, Compounds and Emulsions

ZOPHAR MILLS — QUALITY AND SERVICE — 102 Years — EXPERIENCE

Materials for potting, dipping or impregnating all types of radio components or all kinds of electrical units. • Tropicalized fungus proofing waxes. • Waterproofing finishes for wire jackets. • Rubber finishes. • Inquiries and problems invited by our engineering and development laboratories.

Zophar Mills, Inc. has been known for its dependable service and uniformity of product since 1846.

ZOPHAR MILLS, Inc.
ESTABLISHED 1846
117 26th STREET, BROOKLYN, 32 N. Y.

RCA Adds 33 Set Licensees

New companies who have become RCA receiver licensees from Jan. 1 to June 15 of this year are as follows:

American Television & Instrument Co., 3115 Adams Mill Road, N. W., Washington 10, D. C.; Barnett Radio Electronics Co., 7948 East Firestone Blvd., Downey, Calif.; Bell Cabinet Co., 6001 Van Nuys Blvd., Van Nuys, Calif.; Cleervue Television Corp., 81 Williughby St., Brooklyn, N. Y.; Columbia Television, Inc., 33 Jefferson St., Stamford, Conn.; Cromwell Television Co., 1609 Kings Highway, Brooklyn 29, N. Y.; J. W. Davis & Co., 3015 Knox St., Dallas, Tex.; Eastern States Radio & Television Co., 427 East 138th St., Bronx 54, N. Y.; Electronic Measurements Co., Lewis St., Eatontown, N. J.; Empire Coil Co., 238 Huguenot St., New Rochelle, N. Y.; G. V. Manufacturing Corp., 1001 First Ave., Asbury Park, N. J.; Hollywood Electronics, 1223 Venice Blvd., Los Angeles, Calif.; Lance Television Labs., 1963 Walton Ave., Bronx 53, N. Y.; Lang Radio Enterprises, Inc., 201 East 89th St.. N. Y.; Lavalo Radio & Television, Inc., 317 9th St., Brooklyn, N. Y.; Lipan Radio & Television Co., 2430 Atlantic Ave., Brooklyn 33, N. Y.; Loral Electronics Corp., 794 East 140th St., N. Y. 54, N. Y.; Magnavision Co., 3605 Kingsbridge Ave., Bronx, N. Y.; Manfred Co., 1217 Southern Blvd., Bronx 59, N. Y.; The Minnesota Electronics Corp.. 6th & Minnesota Sts., St. Paul 1, Minn.; National Co. Inc., 61 Sherman St., Malden, Mass.; North Eastern Radio Co., 799 Broadway, N. Y.; Platzman & Kronengold, 385 Flatbush Ave. Extension, Brooklyn 1, N. Y.; Radio Craftsmen, Inc., The 1341-3 South Michigan Ave., Chicago 5, Ill.; Roberts Mfg. Co., P. O. Box 1256, Grand Prairie, Tex.; Spellman Television Co.. Inc., 130 W. 24th St., New York 11, N Y; "Strebor" Incorporated, 721 Bloomfield Ave., Clifton, N. J.; Tel-Ant Electronic Co.. Inc., 217 West 14th St., N. Y. 11, N. Y.; Telecraft Corp., 2 West 15th St., N. Y., N. Y.; Telequip Radio Co., 1901-07 S. Washtenaw Ave., Chicago 8, Ill.; Televiewer Service Co., 7822 Devon St., Philadelphia 18. Pa.; Television Labs., Inc., P. O. Box 929, New Castle, Pa.; White Tuning Corp., 421 West 54th St., New York, N. Y.

Hertzberg Joins EII

Col. Robert Hertzberg has joined Caldwell-Clements, Inc.. 480 Lexington Ave., New York, in the capacity of assistant publisher of *Electronic Industries & Instrumentation.* This firm also publishes *Radio & Television Retailing* and *Tele-Tech.*

Long active in the technical magazine field Hertzberg, until recently, was executive editor of Fawcett's general-science magazine *Mechanix Illustrated.* During the war he served in the Signal Corps in various planning, training and operational assignments. He is a member of the Institute of Radio Engineers, the Armed Forces Communications Association and Advertising Men's Post No. 209 of the American Legion.

KWK installs FM Transmitter

Radio station KWK is now serving the St. Louis area with a newly installed Western Electric 10 kw FM transmitter, with an effective radiated power of 70,000 watts.

A coil manufacturer or A coil user learns a lot about COIL BASES

No matter how fine the quality of wire, how perfectly wound, how well impregnated and varnished, *coils are no better than their foundations.*

PRECISION BOBBINS

To your specifications. Round, square, rectangular, any coil shape.
"Precision" means dependability.
Experienced *selection* of materials: Dielectric Kraft, Fish Paper, Cellulose Acetate, or combinations. Tubes spirally wound for greatest strength. Better insulation. Better heat dissipation. Less moisture absorption. Vulcanized fibre flanges. Swaged tube ends for secure locking.
LIGHTEST WEIGHT. SPACE SAVING.
WEIGHT SAVING.
Let us make up samples for you without obligation. Write

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WPIX, television's most modern station, has selected the Cramer Time Delay Relay to protect expensive tubes . . . prevent energizing plates before filaments reach operating temperature.

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Running Time Meters (Elapsed Time Meters) available in both round or square meter, also portable housings with or without reset.

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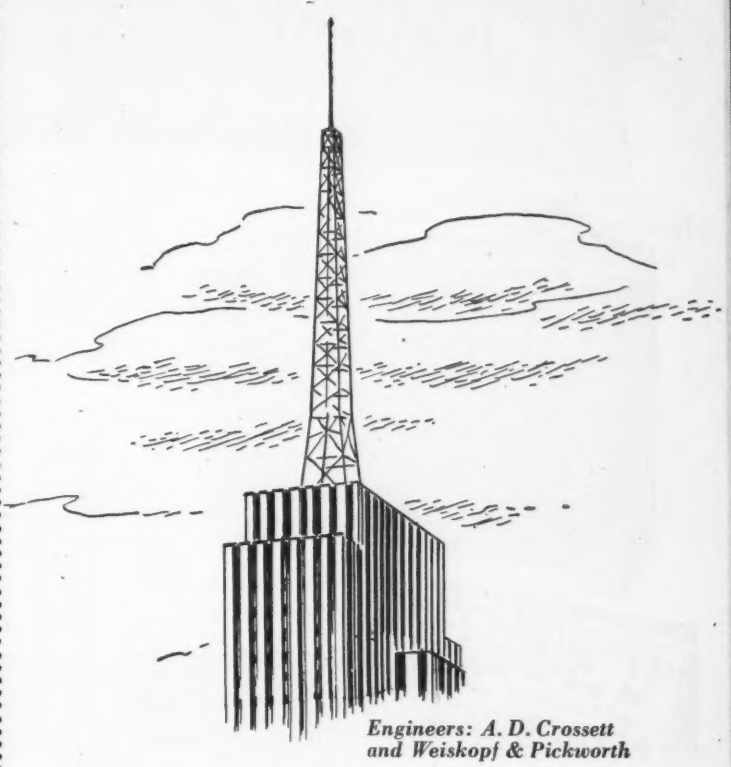

Engineers: A. D. Crossett and Weiskopf & Pickworth

The Daily News' new Television Studio—WPIX

THIS modern television studio, just completed atop the Daily News Building on East 42nd Street, New York City, stands as timely evidence of Turner's ability to produce promptly under today's conditions.

TURNER CONSTRUCTION COMPANY

FOUNDED 1902

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BOSTON CHICAGO PHILADELPHIA

STATION WHKC ...Selects TECH LABS

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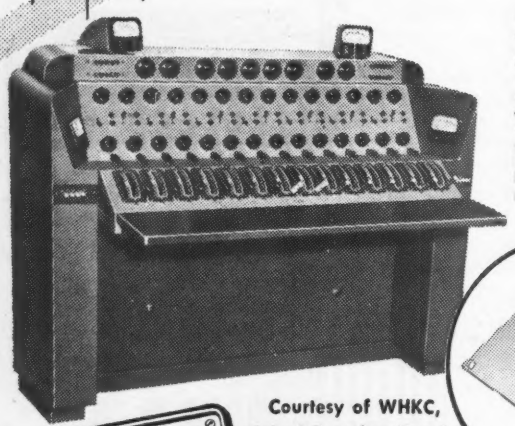
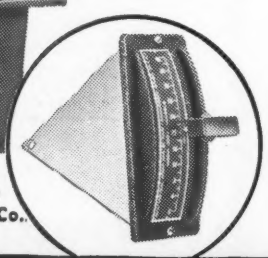
for new CONSOLE INSTALLATION



The flick of a finger operates the patented "Gove" Vertical Attenuator. Representing the very latest in broadcast components, these units are suitable for every type of sound equipment from elaborate broadcast stations to the simplest P.A. system. Unit gives smooth easy operation and can be cleaned from front of panel by removing escutcheon. Completely shielded and dust proof.



Courtesy of WHKC, United Broadcasting Co.

Write for Descriptive Bulletin

TECH LABORATORIES, INC.

Manufacturers of Precision Electrical Resistance Instruments

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WELCH METERS

MASTER TYPE W — No. 3027

A complete line of Portable-Panel and Switchboard A. C. and D. C. Electrical Instruments.

Produced by skilled workmen, with many years' training in designing and building high-grade Electrical Measuring Instruments.

Widely used as Laboratory Standards.

PROMPT DELIVERY

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W. M. WELCH SCIENTIFIC COMPANY

Established 1880

1515 Sedgwick Street, Dept. J, Chicago 10, Illinois, U. S. A.

BULLETINS

Mobile Radio Telephone

A new mobile radio telephone system incorporating a Philco narrow-band FM unit is described in a bulletin released by the Kellogg Switchboard and Supply Co., 6650 S. Cicero Ave., Chicago 38. Two models, the 30-G for the 30 to 44 mc band and the 150-G for the 152 to 162 mc band, are featured. (Mention T-T)

Technical Paper Index

Volume II(b) of the index of RCA technical papers now is available. This index includes all published English-language technical papers on subjects in the radio, electronics and related fields, the author or co-author of which was associated with the Radio Corp. of America. (Mention T-T)

Microwave Components

Standard Microwave Components is the subject of a bulletin published by Waveguide Mfg. & Equipment Co., Inc., 125 E. 23rd St., New York 10. N.Y. Test equipment, waveguide assemblies and miscellaneous components are described. (Mention T-T)

Tube Inventory Guide

A receiving tube Inventory Analysis Guide, ETR-83, for distributor's use in checking and controlling tube stocks, has been brought out by the Tube Div., General Electric Corp., Syracuse, N. Y. Complete with clipboard for use in distributors warehouses, the guide contains sheets for over 600 tubes and is based on estimated replacement sales during a 90-day period by a distributor who sells 50,000 tubes annually. (Mention T-T)

Miniature Tubes

The Radio Tube Division of Tung-Sol Lamp Works Inc., Newark 4, N. J. features its new line of miniature tubes in a rcently published 6-page brochure. Operating characteristics of 30 Tung-Sol vibration tested tubes are included. (Mention T-T)

Broadcast Equipment

Over 250 pages of data on AM, FM, and television equipment is included in the Broadcast Equipment Catalog published by the RCA Victor, Div., Radio Corp. of America, Camden, N. J. (Mention T-T)

Kodagraph Papers

Eastman Kodak Co., Rochester 4, N. Y. has released 2 booklets on Kodagraph papers; one deals with projection papers for use with enlargers, projection printers or process cameras, and the other describes contact paper for photocopying and engineering production. (Mention T-T)

Wire Terminals

Simplifying selection and specification of wiring terminals, the Shakeproof Terminals catalog contains complete dimensional data on all terminals manufactured by Shakeproof Inc., 2501 N. Keeler Ave., Chicago 39, Ill. Shakeproof terminals, locking or plain, are used by electrical manufacturers to simplify wiring assembly. (Mention T-T)

Electric Unit Heaters

The complete line of Electromode Unit Heaters from 1500 to 60,000 watts are described in detail in catalog EC-4, recently published by Electromode Corp., 45 Crouch St., Rochester 3, N. Y. The EC-4 is illustrated with many installation diagrams, pictures of heaters and controls. A heating analysis sheet is included to assist manufacturers in the solution of industrial heating problems. (Mention T-T)

Heating in Woodworking

The application of radio frequency heating in the woodworking industry is treated in a booklet published by the Westinghouse Electric Corp. Photographs and drawings of the units in operation show correct methods of placing the electrodes and obtaining the most effective results for a variety of requirements. Copies of this booklet (B-3946) may be obtained by writing to P. O. Box 868, Pittsburgh 30, Pa. (Mention T-T)

Oscillograph Photography

A 12-page booklet describing oscillograph photography with the Fairchild Oscillo-Record camera is being distributed by the Fairchild Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y. (Mention T-T)

TERMINALS

for

ELECTRIC WIRES

SMALL METAL STAMPINGS

in accordance with your blueprints

PRECISION PARTS

from Modern Equipment

PATTON-MacGUYER CO.

17 VIRGINIA AVENUE PROVIDENCE 5, R. I.

LENSES for TELEVISION

Now Available from BURKE & JAMES, INC.

Just a few examples from the world's largest lens stocks:

2"	F1.5	Hugo Meyer	coated
3"	F1.9	Hugo Meyer	coated
5"	F2	Schneider Xenon	coated
6½"	F2.7	Carl Zeiss (Jena)	coated
7½"	F3.5	Carl Zeiss (Jena)	coated
8"	F2.3	Astro Pan Tachar	coated
18"	F5.5	Magna Telephoto	coated

Lenses available in barrel with iris, straight focusing mounts, or fitted to your camera. Please advise your requirements. We will be happy to quote on 15 day trial basis All offerings subject to prior sale. Direct inquiries to Thomas E. Tell, Burke & James, Inc., 321 S. Wabash Ave., Chicago, Illinois.

TV Headquarters for FILMING EQUIPMENT

Specializing in television, Industrial Cinema Service is a leading supplier of motion picture equipment to television stations.

DISTRIBUTORS & MANUFACTURERS' REPRESENTATIVES

- √ 16mm cameras
- √ Motion picture printers
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- √ Film lab accessories
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a Bell & Howell camera specialized for use in television.

We maintain an engineering service to install equipment and instruct personnel in operation.

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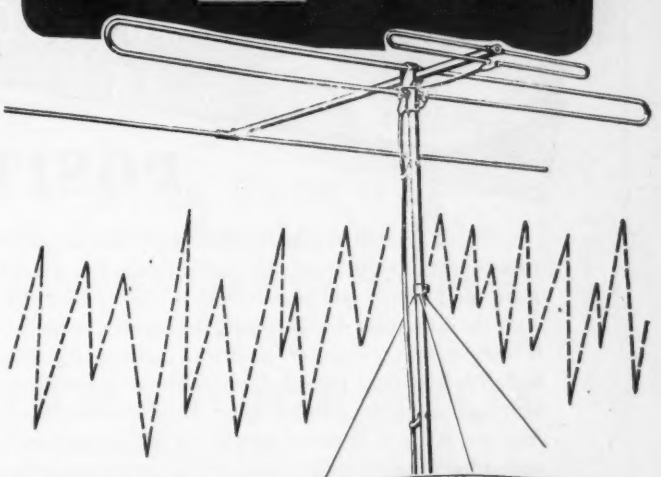
INDUSTRIAL CINEMA SERVICE

221 N. LaSalle Chicago 1, Ill.

Get brilliant, ghost-free reception on all channels of Both bands . . .



install this new AMPHENOL

TELEVISION *Array*

Today, in most communities, a single 54-88 mc folded dipole television antenna is all you need.

Tomorrow, with two television bands in use, an ordinary TV antenna designed for service on either the 54-88 mc, or the 174-216 mc band will not satisfactorily receive the other. So, if you want brilliant reception on *all* channels, in *both* bands, and don't want to buy two antennas, this new Amphenol Television Array is the one to buy.

This antenna array is unique. Its two broadband folded dipoles and reflectors have a common transmission line. This permits the large folded dipole to also serve as a reflector for the small folded dipole.

Amazing as it seems, this arrangement produces more gain than a dipole. This is true over the whole high frequency band, and also over most of the low. In areas of low signal strength, this array delivers brighter, clearer pictures. Also, its highly directional pattern virtually eliminates "ghosts."

Antenna elements and supports are of sandblasted aluminum tubing and aluminum alloy castings. The five foot mast is of cadmium plated steel tubing. Designed to withstand high winds and ice loading, the antenna is easily assembled with ordinary tools. No element length adjustment is required.

Swivel mounting plate and guy clamp permit installation on every type roof. Seventy-five feet of low-loss Amphenol 300 ohm Twin-Lead, which matches the input of most television receivers, is included. A good impedance match is achieved on both bands.

See your jobber, or write direct, for prices and complete technical data.

AMERICAN PHENOLIC CORPORATION

1830 SOUTH 54TH AVENUE • CHICAGO 50, ILLINOIS

COAXIAL CABLES AND CONNECTORS — INDUSTRIAL CONNECTORS, FITTINGS AND CONDUIT — ANTENNAS — RADIO COMPONENTS — PLASTICS FOR ELECTRONICS

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DAMAGE IS LIBEL. Electricity can serve . . . or it can ravage like a wild beast. Electrical damage is a libel on the good name of product and manufacturer alike. Protect YOUR product with the Littelfuse designed for that specific purpose . . . and insure it against the ravages of electrical damage. By incorporating the Littelfuse designed for your product, in your product, you are underwriting it and your good name against the libel of electrical damage. May we tell you more about this effective ***product insurance?*** A note, phone call or ***collect wire*** will bring you complete information.

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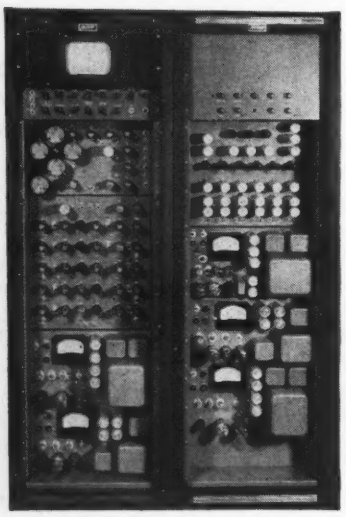
TEST TV TRANSMISSION
★ *and* RECEPTION ★



New
TELEQUIP
SYNC GENERATOR and MONOSCOPE
with
Monoscope Picture Generator and Distribution Panel

Produces regular pictures used with TV transmitters. Gives synchronizing, driving and blanking signals for testing, research and development work, with monoscope controls and distribution signals for use at various points of testing.

Invaluable to manufacturers of TV receivers and broadcasting units for checking faults not likely to be observed by other methods. Can be used at transmitting stations as auxiliary unit. Available either in combination or as separate units.

Now used exclusively by many leading manufacturers of television equipment.

Send for this illustrated monograph completely describing the new Telequip Sync Generator and Monoscope.

TELEQUIP RADIO COMPANY
1905 SOUTH WASHTENAW AVENUE • CHICAGO 8, ILLINOIS

Columbia-Philco Engineer New Record System

Microgroove discs increase playing time 4 to 5-fold

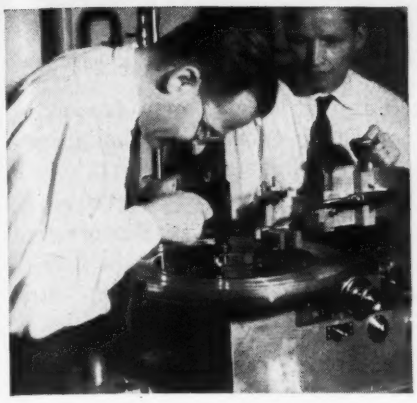
A revolutionary new system of disc records and player units which expand from 4 to 5 times the playing period per disc with fidelity corresponding to present standard records, was demonstrated by the Columbia Records and Philco organizations at New York, June 18, with engineering credit going to Dr. Peter Goldmark of CBS for the records and to David B. Smith and Palmer Craig of Philco for the reproducing and playing equipment.

Using 33 1/3 rpm instead of the usual 78 rpm, and with grooves cut 224 to 300 to the inch (instead of the present standard 96 grooves per inch), the new vinylite discs achieve an increase in playing time of about 5 to one, although in the new commercial records being placed on the market, expansions of only 4 to one are standard.

These Columbia nonbreakable LP (Long-Playing) microgroove records combine economy of manufacture with a record playing time of up to 45 minutes per 12-in. disc. Thus, on one single 12-in. record, the listener can hear, in its entirety, a complete symphony, an entire concerto, or the score of a Broadway musical.

Timing, however, is entirely dependent upon the selections involved. Although a 12-in. side can play up to 22½ minutes, there are

Dr. Peter Goldmark, CBS Director of Engineering (kneeling) and William Bachman, Director of Research for Columbia Records, examine chamber for gold coating master record



Dr. Goldmark of CBS shown inspecting microgrooves in a new "long playing" record

many selections which require less than 22½ minutes to perform. Consequently, a feature of the LP microgroove record is the fact that a selection is complete, regardless of timing, on either one or two sides of a record.

The LP record groove is .003 in. wide, the approximate diameter of a human hair and is played by means of a reproducing stylus with a radius of .001 in., about one-third the diameter of the usual stylus. The type of frequency characteristic adopted throughout the LP system makes the record and player complementary to each other.

Columbia LP microgroove records are priced as follows:

12-in. Masterworks .. $4.85
10-in. Masterworks .. $3.85
10-in. Popular $2.85

The initial catalog of Columbia LP microgroove records will include 101 records covering 325 classical, semi-classical, and popular compositions. These "Long-Playing" records play on one single disc musical works that formerly could be obtained only in albums of up to 6 records. They also drastically reduce the price of such musical works up to 62%.

With the addition of a simple, inexpensive player attachment, Columbia LP microgroove records can be played through any radio or radio phonograph combination. The player attachment retails for $29.95.

The player attachment was developed for Columbia Records by Philco as an integrated unit with the new records. The featherweight tone arm, cushioned in rubber for flexibility and toughness, holds the fine groove on the LP record with a minimum of pressure—1/5 oz. of weight on the record.

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CAMERA

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SHOULD ALSO BE FIRST ON YOUR LIST

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LIGHTING UNITS — CONTROL SYSTEMS

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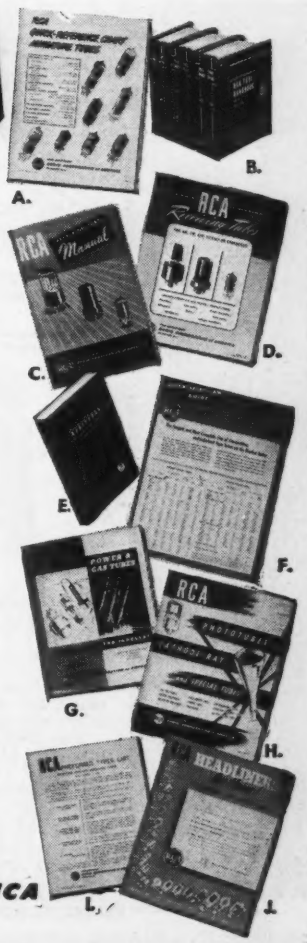


RCA, Commercial Engineering,
Section 7W-87, Harrison, N. J.

Send me the RCA publications checked below. I am enclosing $..... to cover cost of the books for which there is a charge.

Name_____

Address_____

City_____ Zone_____ State_____

- ☐ Quick-Reference Chart, Miniature Tubes (*Free*). [A]
- ☐ HB-3 Tube Handbook (*$10.00*)*. [B]
- ☐ RC-15 Receiving Tube Manual (*35 cents*). [C]
- ☐ Receiving Tubes for AM, FM, and Television Broadcast (*10 cents*). [D]
- ☐ Radiotron Designers Handbook (*$1.25*). [E]
- ☐ Quick Selection Guide, Non-Receiving Types (*Free*). [F]
- ☐ Power and Gas Tubes for Radio and Industry (*10 cents*). [G]
- ☐ Phototubes, Cathode-Ray and Special Types (*10 cents*). [H]
- ☐ RCA Preferred Types List (*Free*). [I]
- ☐ Headliners for Hams (*Free*). [J]

*Price applies to U. S. and possessions only.

TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.

This is the NEW Astatic

MAGNETO INDUCTION PICKUP they're talking about..

... And small wonder, indeed, that such a radical departure from established engineering precedent is causing universal comment in the field. The Astatic Magneto-Induction Pickup Cartridge, contrary to operating principles of previous magnetic type units, eliminates the need for "air gaps." Revolutionary? Yes, in construction and equally so in terms of performance. Absence of delicately spaced air gaps means no more trouble or diminishing quality of reproduction due to lint and dust collection. No more need for delicate handling. No more costly, troublesome armature balancing problems. Free of such limitations, the Magneto-Induction cartridge provides peak, unchanging fidelity of reproduction, under consistent service or adverse climatic conditions. It is another major contribution to greater listening pleasure by Astatic.

Write for Complete Technical Data, Prices.

TWO MODELS NOW AVAILABLE

Model MI-1	Model MI-2
Standard Housing	Mumetal Housing*

*Provides increased shielding effect for maximum reduction of hum.

Two Equalizer-Amplifier Models Available

Model EA-1, compact unit designed for radio sets and audio amplifiers having insufficient gain for operation of Astatic Magneto-Induction Pickup Cartridges. Provides "bass-boost."

Model EA-2 Equalizer-Amplifier, self-powered, provides adjustable "bass-boost" with adjustable treble "roll-off" and selection of "turnover frequency."

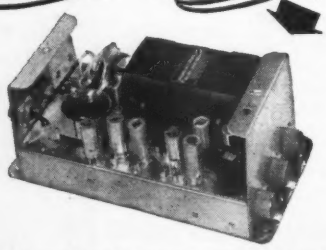
Manufactured under Massa Laboratories License

THE Astatic CORPORATION
ASTATIC CONNEAUT, OHIO
IN CANADA: CANADIAN ASTATIC LTD. TORONTO ONTARIO

"A Well Known Name in Radio for Over 25 Years"

NO. 6 OF A SERIES

Carter powers "Taxi Talkie" Communications Equipment



To provide ample and instant power for their two-way mobile radio system, MOBILE COMMUNICATIONS COMPANY uses the famous CARTER GENEMOTOR shown in the chassis illustrated here. These CARTER units are designed to deliver 100,000 transmissions without servicing. Quick power too—trigger fast! Flick the switch and in 3/10 of a second the Taxi Talkie system surges with power!

For illustrated catalog, specifications and technical data on CARTER rotary power supplies, and name of nearest CARTER distributor, WRITE TODAY.

Carter Motor Co.
Chicago, Illinois

2645 N. MAPLEWOOD AVENUE • CABLE: GENEMOTOR

High Fidelity

(Continued from page 27)

oscillate at their own frequency when shock excited, producing hollow or ringing sounds.

6. *Subharmonic distortion.* Speaker diaphragms may be excited to vibrate in modes below the fundamental frequency. This distortion is very unpleasant.

7. *Doppler effect in speakers.* High amplitude low frequency excursions of the speaker diaphragm causes frequency modulation of high frequency sounds generated by the same diaphragm.

8. *Room acoustics.* Reverberation in the studio is picked up by the microphone in addition to the original sound. Reverberation in the playback room adds to the sound heard by the listener. There are two sets of room acoustics, and apparently no unique, correct solution. Some experts say, "Pickup in a dead room — playback in a live room." Others say, "Vice versa." Others, "Half and half." It is agreed that much depends on the program material.

9. *Spatial distribution.* The speaker size and shape is generally quite different from the original source. Its directional pattern depends on frequency. The binaural effect is lacking.

10. *Dynamic range.* Some very elaborate compressor-expander systems have been devised to extend the dynamic range.

11. *Wow and flutter.* This is an annoying type of distortion because it seldom occurs in natural sounds. Under some conditions the ear can detect the presence of 0.001% flutter, or about 1/100 as much as is present in the best systems of today.

12. *Hum.* In addition to residual hum level at the power frequency or its harmonics, there may also be hum modulation of the signal caused by balanced amplifiers fed with inadequately filtered dc. An effect of this kind also occurs in dynamic speakers with a humbuck coil in the field winding.

Some recent interesting tests made recently by Mr. Olsen of RCA have proved encouragement to Group III members. Mr. Olsen set up some acoustical filters between musicians and audience in a small room. He opened and

closed these filters mechanically and asked the audience for their preference. Sixty-nine percent chose full frequency range rather than the 500 cycle cutoff. Since no electrical system was used at all, none of the usual distortions were present. Olsen's tests would indicate that if the system is binaural and distortionless it sounds better with highs present.

We have given quite a lengthy list of departures from the ideal occurring in even the best sound reproducer systems known today. One of the most worth while improvements in realism of sound reproduction is to recreate the spatial relations of the original source. Properly done, the net gain appears to be far more than the spatial effect, for the listener is less critical of frequency response, non-linear distortion, noise and room acoustics with a binaural system than with a monaural. In fact, it has been stated that a 5000-cycle binaural system is preferable to a monaural system flat to 15 kc.

The photograph shows a magnetic recorder built for experiments with stereophonic sound. The drive unit at the left holds a 7-in. reel of tape ½ in. wide with a total recording time of 40 minutes. The center unit has a monitor-control panel at the bottom, and an amplifier for channel No. 1 at the top. The right hand unit contains amplifiers for channels No. 2 and 3.

Equipment specifications are:

Frequency response: Flat from 30 to 10,000 cycles within ± 5 db;

Noise level: 60 db below signal;

Distortion: 4% intermodulation or 1% harmonic;

Wow and flutter content: Less than 0.1%;

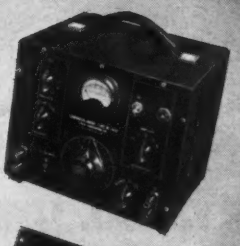
Number of channels: Three.

The block diagram shows a typical setup for stereophonic recording and playback. Sound is picked up by 3 spaced microphones, recorded on separate channels, and played back through 3 spaced speakers. On playback the effect is not of sound coming from any particular speaker but from points in space somewhere between the speakers. Choirs and symphony orchestra are particularly effective when presented stereophonically and give the illusion of actual presence within the room.

LABORATORY TEST EQUIPMENT

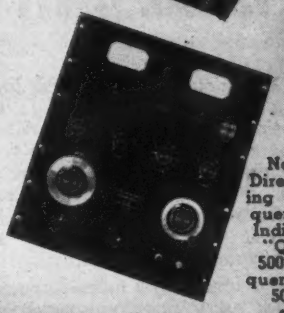
by FREED

No. 1020 Direct Reading Megohmeter up to 1,000,000 megohms. Self contained. A.C. operated.



No. 1010 Comparison and Limit Bridge. Self contained. A.C. operated.

No. 1040 Wide Range Vacuum Tube Voltmeter.



No. 1030 Direct Reading Low Frequency "Q" Indicator — "Q" .5 to 500 — Frequencies from 50-50 000 cycles.

No. 1110 Incremental Inductance Bridge.

FREED

TRANSFORMER CO., INC.

Instruments Division

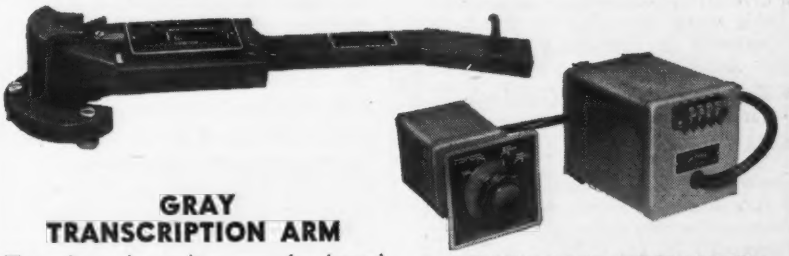
78 SPRING STREET NEW YORK 12, N. Y.

The Combination of

GRAY TRANSCRIPTION ARM, No. 601 4-position EQUALIZER and SELECTED GE CARTRIDGE . . .

. . . is receiving WIDE ACCLAIM!

Developed in collaboration with the COLUMBIA BROADCASTING SYSTEM for finer lateral reproduction, it is now standard equipment in two major networks.



GRAY TRANSCRIPTION ARM

This, the only modern arm for lateral reproduction, greatly extends the life of stylus and recordings. Adjustable stylus pressure, accommodates all modern cartridges. Ideal for **Micro-Groove** reproduction. Many other new features. Arm, less cartridge, $35.00.

GRAY #601 EQUALIZER for GE CARTRIDGE

Optimum Performance, Economy of Operation and Quality Workmanship. Matches pickup to microphone channel. Complete, $42.50.

Write for more details (including Gray Selected GE Cartridges with Diamond Styli, and Micro-Groove reproduction).

GRAY RESEARCH & DEVELOPMENT COMPANY, Inc.

Factory: Hartford, Conn. • Sales: 565 FIFTH AVENUE, NEW YORK 17

IN THIS CORNER

weighing .1 ounce

TYPE G64A CRYSTAL UNIT

TYPICAL of the outstanding crystal developments at General Electric is this miniature-size crystal unit for oscillator frequency control from 6 to 10 mc (conservative rating). Its small size and weight make it an ideal unit for aviation equipment, transmitter output frequency control, receiver local oscillator frequency and many other types of equipment.

Here are a few of the more important features that mean improved equipment through the use of the G64A:

- Because of its low capacitance, this unit readily lends itself to "overtone" or "mechanical harmonic" operation
- Low terminal capacitance (6 mmfd or less)
- Plated-on electrodes
- Both sides "high"
- Resilient crystal plate mounting to withstand severe mechanical shock
- Crystal plates secured to mounting springs with silver-filled, thermosetting cement, to insure adequate mechanical and electrical bond between plating and springs
- Operating temperature range: − 55°C to + 90°C
- Overall frequency deviation over this range, including initial adjustment in customer's circuit, ± .005%
- True hermetic sealing (shell soldered to base)
- CAA approved

Fundamental operation may be extended up to approximately 15 mc, and, by using the "overtone" modes and a suitable circuit, the range may be extended up to 75 mc and higher.

Other crystal units are available for most applications, and for those special cases which present tough problems G.E. will engineer crystals to suit your requirements.

For complete information on crystals write: *General Electric Company, Electronics Park, Syracuse, New York.*

165-G1

GENERAL ELECTRIC

PERSONNEL

George M. Lebedeff has joined Lenkurt Electric Co. as carrier engineer. He was formerly chief engineer of Heintz & Kaufman Ltd.

Dr. Winston L. Hole has been named assistant to the director of the Ohio State University Research Foundation. He was formerly coordinator of engineering development for North American Philips.

Charles R. Schmidt has joined the staff of Airlectron Engineering Co., Caldwell, N. J., as assistant chief engineer. Formerly he was electronic engineer with Finch Facsimile, Curtiss Wright and Federal Telephone and Radio.

Albert J. Friedman has been appointed chief antenna development engineer of the J.F.D. Mfg. Co. He was formerly with Federal Telephone & Radio

B. B. Bauer has been named vice-president of Shure Bros., Inc. He joined the company in 1936, becoming chief engineer in 1940 and director in 1944

Dr. Henry H. Hausner has joined the staff of the Metallurgical Research and Development Laboratories of Sylvania Electric Products, Inc. A research associate and professor in the graduate division of New York University, he was formerly chief research engineer for the Ceramics & Steatite Corp.

J. C. Farley has been appointed general manager of the radio division. He was previously controller.

Paul L. Chamberlain has succeeded **Philip G. Caldwell** as manager of sales in the transmitter division, General Electric Corp.

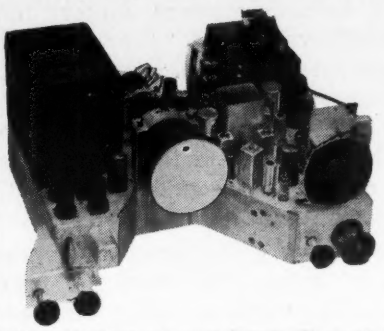
Charles A. Hampton has joined the Federal Telephone and Radio Corp. as sales representative for the mobile radiotelephone division, covering Washington and northern Idaho.

L. M. Skelton has been named to represent the Kester Solder Co.'s technical science dept. in troubleshooting solder user's production problems.

George V. Altgroth has joined Eckert-Mauchly Computer Corp., Philadelphia, as patent counsel.

PROJECTION TELEVISION!

PROJECTION TELEVISION CHASSIS



This outstanding set using famous 630 circuit is a modified version to accommodate 5TP4 Projection Tube. The intense source of light on the face of the projection tube enables set to project pictures onto screens of sufficient size to be utilized by auditoriums and small theatres. FEATURES: Set, less 30 KV RF Power Supply, contains 30 tubes. Full 13 channel coverage; FM sound system; A-F-C horizontal hold; stabilized vertical hold; 2 stages of video amplification; noise saturation circuits; three stage sync separator and clipper; four mc. band width for picture channel. Exclusive Cutout Relay to protect projection kinescope in the event of sweep failures! Net Price—(Includes all tubes, less projection tube) $340.00

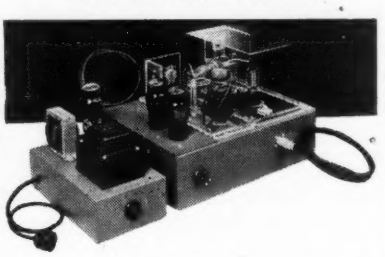
Chassis as above, but designed for 10" or 15" tube use. relay circuit not included. Set complete less kinescope, ready to operate. Net Price $298.00

The following basic units comprise a complete package for projection television suitable for custom work:

F 1.9 TELEVISION PROJECTION LENS

Dimensions: Length 7", Diameter 4¼".
F 1.9 EF. 5 in. (127.0 mm). This lens incorporates in barrel a corrective lens for use with a 5TP4 projection tube. It is easily removable for use wtih flat type tubes. Lens can be utilized to project picture sizes from several inches to 7 x 9 feet. Made by Bausch & Lomb Optical Co.
Net Price $125.00
Mounting ring available for above lens .. $2.50

30 KV RF POWER SUPPLY



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letters to the editor...

Myriametric Arythmic Systems

Dear Sir:

Before going into the details of this communication problem, it is only fair to state that the title and sub-title are purely synthetic. Their chief function is to call to your attention that British communication engineers apparently employ some words that are not familiar to most of their fellow engineers in the U.S.A., even though they are established English words.

These words, and a number of others strange to us, are all found in the publication "Glossary of Terms Used in Telecommunication." This is published by the British Standards Institution. It is a well prepared booklet of about 100 pages having the designation British Standard 204:1943. It is obtainable from the British Standards Institution, 28 Victoria Street, London, S.W.1 and in London may be purchased for 5 shillings.

The following words and definitions quoted from this booklet are of interest because they are novel to most communication engineers in this country:

Ancillary — Subsidiary answering point in communication.

Arythmic System — Start-stop system of signalling, sort of a "gating" idea.

Baud—Unit of telegraphic speed.

Cadence—A signal for the operator of a telegraph keyboard to depress a group of keys.

Chronopher — A switching instrument for sending time signals over other circuits.

Cradle Switch—As on a French phone set.

Fortuitous Distortion — Distortion due to irregularities in any part of circuit or apparatus.

Isolator—Equivalent to buffer.

Logatom—An isolated syllable, initial consonant + vowel + final consonant.

Myriametric — Wavelengths above 10,000 meters.

Poling—Interchange of conductors in a transmission circuit in order to detect any alteration in characteristics.

Psophometer—An instrument to give indication of disturbing voltages of various frequencies.

Rocky Point Effect—A sudden increase of current thru a high-vacuum tube.

Routiner—An equipment in automatic telephony for testing automatically.

Skinner — The length of insulated wire between a laced cable form and the connecting point.

W. C. White

Research Laboratory, General Electric Co., Schenectady, N. Y.

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Westinghouse Electric Corp. successfully demonstrated stratovision June 23 and 24 before news and magazine editors in Zanesville, Ohio. A converted B 29, flying at 25,000 ft., picked up a broadcast signel from WMAR-TV, Baltimore, 200 air miles away, and rebroadcast it from Pittsburgh over a 500 mile area. Many rural communities saw television for the first time as a result of the demonstration.

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The Practical Aspect of the Future of Radio

TELEVISION AND F-M RECEIVER SERVICING

by MILTON S. KIVER
Registered Professional Engineer

As every radio man knows, the limitless possibilities of radio in the fields of F-M and television broadcasting are no longer "just talk"—the future of radio has arrived! With more and more F-M and television sets on the market and in operation, no student or service man can afford to be without the wealth of up-to-the-minute, practical information in this great new book.

Written by the author of *U.H.F. Simplified, F-M Simplified* and *Television Simplified*, this simple, well-organized text makes crystal clear all types of servicing problems. There are specific directions for installing television receivers, and for diagnosing, locating and repairing the common troubles of F-M or television receivers. In addition, complete alignment and servicing instructions are given at each point of a logical step-by-step procedure. These are summarized in separate chapters (one for television, one for F-M) so that explanations and instructions are fully coordinated.

The student or service man familiar with present-day A-M receivers easily understands every page of this book. Mathematics is kept to a minimum—just enough to enable the service man to compute properly the lengths of transmission lines and antennas. The book is profusely illustrated with valuable schematic diagrams and photographs.

CONTENTS — The Antenna System, Operation and Installation; Television Receiver Installation; Television Test Equipment; The Television Receiver, Operation and Servicing (4 chapters); Television Receiver Alignment; Trouble-Shooting; Television Receivers; F-M Fundamentals; Commercial F-M Receiver Circuits; F-M Receiver Alignment; F-M Receiver Servicing.

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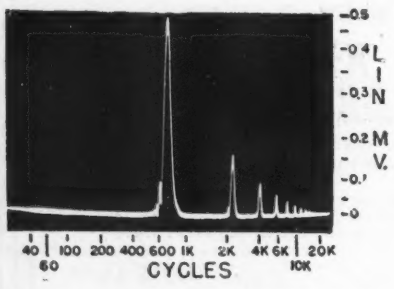

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BOOKS

Theory and Application of Microwaves

By A. B. Bronwell, Northwestern University and R. E. Beam, Northwestern University, published 1947 by McGraw-Hill Book Co., New York, 470 pages, price $6.00.

This is a text or reference book devoted to the fundamental theory of microwaves and their application to communications. It treats transmission line equations, the use of impedance diagrams in solving transmission line problems, and transmission line networks. The various chapters deal with the propagation and reflection of plane waves, solution of the wave equations, wave propagation, oscillations of cavity resonators, radiation from antennas, and directional radiating systems. Carefully selected problems are included which, together with the excellent arrangement and selection of the material, make this book an excellent text book for communication courses.

The Science and Engineering of Nuclear Power

Edited by Clark Goodman, Massachusetts Institute of Technology. Published by Addison-Wesley Press, Inc., Cambridge (42), Mass. 500 pages, 7¾ x 10½", cloth bound edition $7.50, Paper Bound (student edition), $6.00.

This book covers basic nuclear pile design, its practical application, in addition to and the background material necessary for their understanding. Allied subjects such as control, monitoring, chemistry of heavy elements, and fission products are also treated. Contains a Segre' Isotrope Chart, containing a fairly complete summary of important properties of nuclei, both stable and radioactive.

Broadcast Operators Handbook

By Harold E. Ennes, Engineer, "Wire". Published by John F. Rider, Inc., 404 Fourth Ave., New York 16, N. Y. 265 Pages. Price $3.30.

The first four parts of the book cover the operating practice in control rooms, the master control, remote controls, and the transmitter; the fifth and sixth parts discuss technical data for operators and technicians, including maintenance instructions. Intended both for the newcomer to the broadcasting field, and to the experienced operators as well.

High Vacua Principles, Production and Measurement

By Swami Jnanananda, (Univ. of Michigan) Published 1947 by D. Van Nostrand Co., Inc., New York. 310 pages, illustrated. Price $5.50.

An extended analysis of the different types of vacuum pumps and their performance in operation with various applications. Methods for getting the most effective results from a pump are described. A preliminary treatment of the theory of gases with a review of all of the physical laws involved in the kinetic theory of gases, makes up

(*Continued on page* 112)

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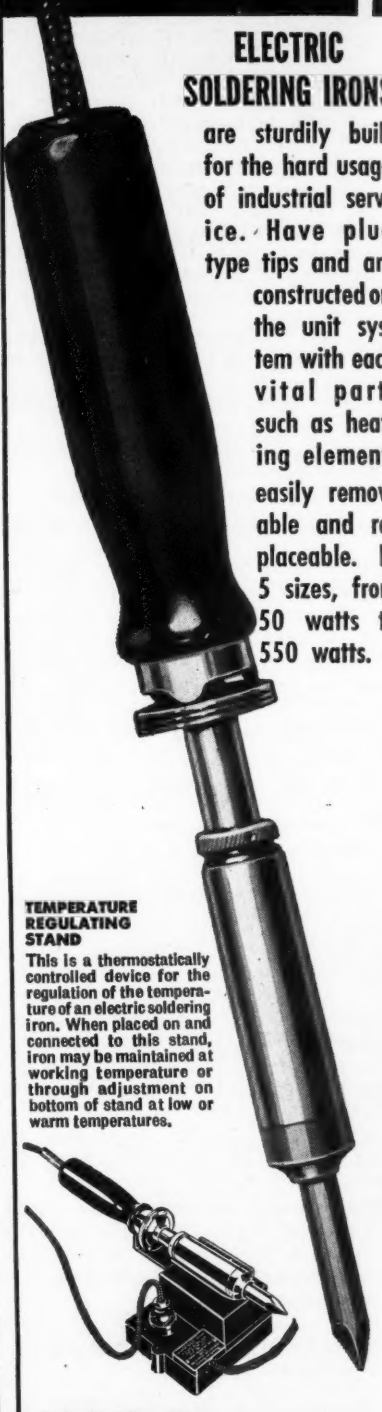

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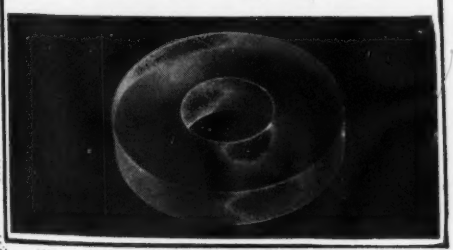

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(*Continued from page* 110)

the first chapter. Vacuum pumps and molecular pumps of all usual types are taken up in the second chapter, followed by an analysis of the methods of measurements, and the operating technics in setting up vacuum systems.

Piezoelectricity

By Walter Guyton Cady, Ph.D., Sc.D., Professor of Physics, Wesleyan University, published by McGraw-Hill Book Co., New York City, 806 pages, $9.00.

The book is intended for research workers as well as for students of physics and radio amateurs who wish to learn more about crystals. The author presents a comprehensive treatise on the entire field of piezoelectricity, including related areas of elasticity, dielectrics, optics, and magnetism. A unified account is given of experimental results, with many formulas, numerical data, and an extensive bibliography.

Techniques of Experimental Electronics

By C. H. Bachman. Published 1948 by John Wiley & Sons, Inc., 340 - 4th Ave., New York 16, N. Y. 252 pages, Price $3.50.

The material covered is particularly concerned with methods for constructing and evacuating electron tubes, particularly those using controlled beams methods of applying and using fluorescent materials, cathode coatings, tungsten characteristics, and vacuum glass blowing technics are covered. A type of device particularly described is the electron microscope.

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